THE 1998 SUSQUEHANNA RIVER BASIN WATER QUALITY ASSESSMENT 305(b) REPORT

Publication 201 *November 1998*

SUSQUEHANNA RIVER BASIN COMMISSION
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The 1998 Susquehanna River Basin Water Quality Assessment 305(b) Report

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This report was prepared to meet the requirements of Section 305(b) of the Clean Water Act. The format used is specified by the U.S. Environmental Protection Agency in its "Guidelines for Preparation of the 1996 State Water Quality Assessments (305(b) Reports)."

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The Susquehanna River Basin Commission was created as an independent agency by a federal-interstate compact* among the states of Maryland, New York, Commonwealth of Pennsylvania, and the federal government. In creating the Commission, the Congress and state legislatures formally recognized the water resources of the Susquehanna River Basin as a regional asset vested with local, state, and national interests for which all the parties share responsibility. As the single federal-interstate water resources agency with basinwide authority, the Commission's goal is to effect coordinated planning, conservation, management, utilization, development and control of basin water resources among the government and private sectors.

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INTRODUCTION

This report summarizes the Susquehanna River Basin Commission's (SRBC's) assessment of designated use support status of its basin's rivers and streams. These assessments are based on monitoring activities from several water quality programs during the period 1996 to 1997. This report, which was prepared to meet the requirements of Section 305(b) of the Clean Water Act, is formatted according to the U.S. Environmental Protection Agency (US EPA) in its "Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates (September 1997)."

The guidelines require the use of water quality, biological, and physical habitat evaluations to determine the degree of use support. The assessments made in this report represent updates to the assessment made in the previous 305(b) report, "The 1996 Susquehanna River Basin Water Quality Assessment 305(b) Report," issued December 1996.

PART I: EXECUTIVE SUMMARY

The Susquehanna River drains 27,510 square miles from parts of New York, Pennsylvania, and Maryland, and contributes over half of the freshwater inflow to the Chesapeake Bay. Of the basin's 31,193 total stream miles, 3,519.8 are assessed in this report. Seventy-two percent of the assessed streams (2,524.77 stream miles) fully support designated stream uses.

Major causes of stream impairment are nutrient enrichment and habitat alteration from agricultural runoff. Other causes of significant stream impairment in the basin include metals, pH, total dissolved solids, and habitat alteration from coal mining activities.

SRBC's monitoring program developed out of its responsibilities and jurisdiction in interstate and regional issues. To support the goals of the Chesapeake Bay Program, SRBC monitors nitrogen, phosphorus, and sediment in the main stem Susquehanna River and its major tributaries. SRBC also established an interstate water quality network to assess compliance with state water quality standards for streams that cross state lines. Finally, regional water quality and biological conditions in the basin are addressed through six subbasin surveys. These monitoring networks not only help SRBC meet each program objective, but also provide information to assess streams for the 305(b) report.

Observed trends in nutrients and sediment water quality along the Susquehanna River at three main stem stations and three stations at the mouth of major tributaries provide evidence of both improvement or no change in stream quality. From 1985 to 1997, phosphorus and suspended-sediment trends have been holding steady (no trend) or improving (decreasing trend), while nitrogen trends improved at all six stations.

PART II: BACKGROUND

The Susquehanna River drains the largest basin on the Atlantic coast of the United States and is the nation's sixteenth largest river. It originates at Otsego Lake, New York, and flows 444 miles to the Chesapeake Bay at Havre de Grace, Maryland. The 27,510-square-mile

Susquehanna River Basin drains portions of New York, Pennsylvania, and Maryland and provides over half of the freshwater inflow to the Chesapeake Bay. Although relatively undeveloped, some of the basin's water resources have experienced degradation and overuse.

Total Waters

The information presented in Table 1 and Figure 1 provides a general perspective of the Susquehanna River Basin's water and land resources.

Summary of Classified Uses

Three different state lists (Table 2) are used to define the classes of streams in the Susquehanna River Basin, since the basin is comprised of parts of three states. Stream classifications are based on a combination of aquatic life, water supply, and recreational uses.

Table 1. Susquehanna River Basin Geographic Statistics

Basin Population [1]		3.85 million
Basin Surface Area [2]		27,510 sq. mi.
- New York		6,327 sq. mi.
- Pennsylvania		20,908 sq. mi.
- Maryland		275 sq. mi.
Number of Water Subbasins [3]		6
- Chemung		2,604 sq. mi.
- Upper Susquehanna		4,944 sq. mi.
- Middle Susquehanna		3,755 sq. mi.
- West Branch Susquehanna		6,992 sq. mi.
- Juniata		3,406 sq. mi.
- Lower Susquehanna		5,809 sq. mi.
Total miles of rivers and streams [4]		31,193.0 mi.
- Miles of perennial rivers/streams		26,064.0 mi.
- Miles of intermittent streams		5,500.7 mi.
- Miles of ditches and canals		45.3 mi.
- Border miles of shared rivers/streams		0.0 mi.
Number of lakes/reservoirs/ponds [4]		2,293
Acres of lakes/reservoirs/ponds [4]		79,687 acres
Square miles of estuaries/harbors/bays [4]		0 sq. mi.
Miles of ocean coast [4]		0 mi.
Miles of Great Lake shores [4]		0 mi.
Acres of freshwater wetlands[4]		unknown*
Acres of tidal wetlands [4]		0 acres
Land use [5]		
- Forested	(63.1%)	or 17,362 sq. mi.
- Urban	(9.3%)	or 2,560 sq. mi.
- Pasture	(6.7%)	or 1,845 sq. mi.
- Agriculture (Cropland)	(19.4%)	or 5,338 sq. mi.
- Water	(1.5%)	or 405 sq. mi.

Sources of Information

[1] U.S. Bureau of the Census, 1991.
[2,3] Susquehanna River Basin Study Coordination Committee, 1970.
[4] U.S. Environmental Protection Agency, 1993b.
[5] Ott and others, 1991.
* May be available from Fish and Wildlife Service, U.S. Department of Interior

Figure 1. The Susquehanna River Basin With Its Subbasins

Table 2. ***Summary of Stream Classifications in the Susquehanna River Basin and Degree of Use Attainment***

State	Classification*	Total Miles Assessed	Miles Attained	Miles Partly Attained	Miles Not Attained
New York	A	9	9		
	A(T)				
	A(TS)				
	AA				
	B	24	20	4	
	B(T)	1.5		1.5	
	C	269.08	216.48	43.2	9.4
	C(T)	62.3	48.9	12.4	1
	C(TS)	20.1	20.1		
	D				
Pennsylvania	WWF	1,329.12	780.81	474.71	73.6
	HQ-WWF				
	TSF	626.53	441.08	142.95	42.5
	HQ-TSF	13.9	13.9		
	CWF	721.37	558.15	114.9	48.32
	HQ-CWF	332.77	322.77	10	
	EV				
	Classes with MF	27.8	25.7	2.1	
Maryland	I-P	19	15	4	
	III-P	5.53	4.28	1.25	
	IV-P	57.8	48.6	9.2	
Total		**3,519.80**	**2,524.77**	**820.21**	**174.82**

* See Appendix A for definitions.

PART III: SURFACE WATER QUALITY ASSESSMENT

Chapter One: Surface Water Monitoring Program

SRBC operates under the general authority of the Susquehanna River Basin Compact, the broad objectives of the commission's Comprehensive Plan, and the guidelines of the commission's overall strategic plan. The strategic plan, adopted in 1995, is designed to guide commission activities through the year 2000. The commission's Division of Water Quality and Monitoring Programs then developed its own plan to complement the overall strategy and focus on specific goals, objectives, and actions to help the commission more effectively manage water quality in the Susquehanna River Basin.

Fixed station nutrient monitoring network

US EPA's September 1983 Management Study, Chesapeake Bay: A Framework for Action (1983a) states the Susquehanna River Basin is dominated by nonpoint sources, which account for 90 percent of the nitrogen and 76 percent of the phosphorus loads within the Susquehanna basin. In response, SRBC initiated a water quality monitoring program in October 1984 to provide nutrient loading and trend information for the main stem Susquehanna River and its major tributaries. SRBC documents nutrient concentrations, loadings, and trends on an annual basis at six monitoring sites.

The collection of nutrient data above the fall line at stations on the main stem and large tributaries was deemed necessary to enable accurate allocation of loadings to the main river reaches and major subbasins. Each site represented large areas (over 400 square miles) having significant differences and levels of complexity, in terms of geological setting and land uses. In most cases, the sites were existing stations sampled by different agencies for one purpose or another over a period of years and where flow measurements were available or facilities for such measurements could be readily installed. These sites are:

1. Susquehanna River at Towanda, Pa.;
2. Susquehanna River at Danville, Pa.;
3. West Branch Susquehanna River at Lewisburg, Pa.;
4. Juniata River at Newport, Pa.;
5. Susquehanna River at Marietta, Pa.; and
6. Conestoga River at Conestoga, Pa.

The scope of the current monitoring program includes the following objectives:

1. To measure concentrations and estimate nutrient and suspended sediment loads over a wide range of stream flows at the current network of stations.
2. To establish a sound database to effectively plan and implement immediate and long-range nutrient reduction efforts. The environmental measurements and analyses will provide loading data for the main stem and the selected major tributaries in sufficient detail to:

    a. Allow Chesapeake Bay Watershed model refinement and verification.
    b. Track and better define nutrient loading dynamics.
    c. Relate measured load fluctuations to changes in water discharge due to precipitation events of varying intensities, durations, and seasons.
    d. Evaluate nutrient loading trends.

The collection of water quality samples representative of river conditions is essential for a successful nutrient monitoring program. Samples are collected at each site to measure nutrient and suspended sediment concentrations during periods of low and high flow. Low flow samples are collected monthly. High flow samples are collected for five storm flow events each year. Daily collection of storm samples occurs at the major river sites from the start of the storm to the time when the flow recedes close to its pre-storm discharge rate.

Long-term monitoring at the six major river stations in the Susquehanna River Basin shows significant changes in total nitrogen, total phosphorus, and suspended sediment (Table 3).

Table 3. Trends in Total Nitrogen (TN), Total Phosphorus (TP), and Suspended Sediment (SS) From SRBC's Fixed Station Nutrient Monitoring Network

Station (Period)	Parameter	Flow-Corrected Concentration Trends			
		Lower Confidence Limit	Trend Estimate	Upper Confidence Limit	p-Value*
Towanda (1989-97)	TP	-2	25	58	0.0667
	TN	-37	-29	-20	0.0000
	SS	-67	-39	12	0.0994
Danville (1985-97	TP	-40	-25	-6	0.0110
	TN	-35	-28	-19	0.0000
	SS	-47	-26	2	0.0656
Lewisburg (1985-97)	' TP	-28	-4	28	0.7798
	TN	-23	-13	-3	0.0119
	SS	-11	31	92	0.1692
Newport (1985-97)	TP	-53	-43	-31	0.0000
	TN	-30	-24	-18	0.0000
	SS	-54	-33	-2	0.0367
Marietta (1987-97)	TP	-40	-28	-13	0.0009
	TN	-39	-33	-25	0.0000
	SS	-61	-48	-30	0.0000
Conestoga (1985-97)	TP	-68	-59	-47	0.0000
	TN	-21	-15	-9	0.0000
	SS	-57	-50	-42	0.0019

* Trend is significant where p-Value <0.05

The greatest improvements occurred in nitrogen at all stations and in phosphorus and sediment primarily in the southern part of the basin. The least amount of change in nutrients and sediment occurred in areas containing large tracts of forested land such as the watershed upstream of the Lewisburg station.

Interstate stream water quality network

SRBC began the interstate water quality monitoring network (ISWQN) in April 1986 to monitor the water quality and biological condition of streams that cross state borders in the Susquehanna River Basin. The ISWQN was established because monitoring programs conducted by New York, Pennsylvania, and Maryland do not produce comparable data and do not assess all the interstate streams.

The original 36 stations were sampled annually, and some of those streams judged to have a high potential for degradation were sampled once each month. Benthic macro-invertebrates were monitored annually at all stations. In November 1987, the program was modified to sample on a quarterly basis and to improve the quality of the data being collected. Laboratory analyses were added for the dissolved fractions of most water quality parameters. Also, analyses of total and dissolved solids were included to provide information on how storm runoff and sediment loads affect water chemistry.

In October 1989, the ISWQN was modified again to eliminate some of the streams and to increase the sampling frequency at the remaining stations. The streams removed from the network were small, first-order streams with good water quality and little potential for degradation. Thirty-one streams remained in the network. Fifteen of the streams were sampled once every other month, with the exclusion of January and February. The other 16 streams were sampled annually during July and August. In July 1996, the ISWQN was reduced from 31 streams to 29, with modifications to the sampling frequency. Fifteen stations were sampled quarterly, while the remaining 14 stations were sampled annually in July and August.

The monitoring program includes periodic collection of water for chemical analysis and biological samples from interstate streams. Chemical data are used to: (1) assess compliance with state water quality standards; (2) characterize stream quality and seasonal variations; and (3) build a database for the future assessment of water quality trends. Biological conditions are monitored by assessing benthic macroinvertebrate populations. Macroinverte-brate populations provide an indication of the biological health of a stream and serve as indicators of water quality.

Temperature, dissolved oxygen, conductivity, pH, alkalinity, and acidity are measured in the field. Water samples are collected at each of the sites to measure nutrient and metal concentrations. Water samples are collected using a depth-integrating sampler. Composite samples are obtained by collecting eight depth-integrated samples across the stream channel and combining them in a churn. The samples are then sent to the Pennsylvania Department of Environmental Protection (Pa. DEP), Bureau of Laboratories in Harrisburg, Pa., for analysis.

Benthic macroinvertebrates are collected annually from stations during July and August. Macroinvertebrates are sampled to provide an indication of the ecological condition of the stream. Sampling is performed using a 1-square-meter kick screen with size No. 30 mesh. The kick screen is stretched across the current and a common garden hoe is used to dislodge the macroinvertebrates from the substrate. The current carries the dislodged macroinvertebrates into the seine. The macroinvertebrates are washed from the seine and preserved in alcohol for identification in the laboratory. Two kick screen samples are collected at riffle sites at each station. Benthic macroinvertebrate samples are assessed using the procedures described in Rapid Bioassessment Protocols for Use in Streams and Rivers (RBP III) (Plafkin and others. 1989).

Stream discharge is measured at all stations unless high streamflows make access impossible. Several stations are located near United States Geological Survey (USGS) stream gages. Stream discharges from these stations are reported as instantaneous discharges in cubic feet per second (cfs). Instantaneous discharge for stations not located near USGS gaging stations is measured at the time of sampling, using standard USGS procedures (Buchanan and Somers, 1976).

All water quality and biological data are stored in SRBC's computer system. Reports are published on an annual basis and are available from SRBC.

Water quality and biological subbasin surveys

SRBC staff has been conducting water quality and biological surveys on selected streams within each of the six major subbasins (Figure 1, page 4). The first round of subbasin surveys began in 1982, and a second round of surveys began in 1993. Chemical and biological investigations are conducted to assess the condition of streams in the basin, identify impaired stream reaches and sources of impairment, provide a screening tool for many streams for possible further investigations, compare most current assessments with historical data, and provide data for the 305(b) reports.

The surveys are designed to rotate among six major subbasins, sampling a subbasin once every 10 years. Sampling is conducted from mid-summer to early fall, when streamflows are maintained primarily by baseflow. The sampling objective is to collect a single sample at each site over a relatively short time period. Station locations on the main subbasin river are located so that the effects of major tributaries on the river can be evaluated, and water quality variations along the river due to point and nonpoint source changes (e.g., acid mine drainage (AMD) inputs and urban areas) can be documented. On tributary streams, stations usually are located near the mouth and at some mid-watershed point upstream. Two sites are used because of potential differences in geologic setting and sources of pollution within the watershed.

A grab sample is taken at most stream locations. On large streams where bridges are present, samples are taken from the bridge using a depth-integrating sampler. At each bridge station, eight equally-spaced verticals are collected and

composited. In a 3-week period, as many as 60 to 90 stations are sampled in each subbasin.

Water quality analyses include indicators for nutrients, metals, and physical parameters. A MultiVariate Statistical Package (MVSP) developed by Kovach (1993) is utilized to develop a classification scheme based on major ions, metals, nutrients, and physical water quality parameters collected at all stream stations in the survey.

Habitat conditions at each study site are assessed using a slightly modified version of the habitat assessment procedure outlined by Plafkin and others (1989). Eleven habitat features of substrate, instream cover, channel morphology, and riparian and bank structure are field evaluated at each site and used to calculate a site-specific habitat assessment score. Habitat assessment scores are used to assess habitat conditions of study sites relative to those of reference sites.

Benthic macroinvertebrate community integrity is assessed using slightly modified versions of the eight RBP III metrics described by Plafkin and others (1989). For each of the study sites, a 100-organism subsample data set is used to calculate numerical values for five metrics. Each of the five metric values is assigned a biological condition score according to the comparability (percent similarity) of these values with the metric values calculated for reference sites, and the sum of biological condition scores constitutes the total biological score for each site. Finally, benthic macroinvertebrate community integrity at each of the study sites is summarized by assigning each study site to a biological condition category. The biological condition category designation is determined based on the comparability (percent similarity) of total biological scores of study sites with those of reference sites.

All water quality and biological data collected from the subbasin surveys are stored in SRBC's computer system. Reports are published following each survey and are available from SRBC. A one-page report announcement is published and widely distributed.

Monitoring/data management needs

The emergence of computer technologies such as geographic information systems (GIS) has created new and powerful tools for the water resource professional. The use of GIS technology as a tool for stream assessments could link the traditional water quality database with geographic data to portray graphic and tabular outputs of various water resource relationships. For example, we could better determine cause and effect relationships in streams if we fully implemented GIS tools and linked GIS to water quality models. If a sample station showed degraded conditions from some unknown source, the GIS could provide some insight into that unknown source by mapping National Pollutant Discharge Elimination System (NPDES) discharge sites, landfill sites, industries, and other sites with the pollutants known to be associated with them. This may provide some indication of possible sources of contamination related to the impaired stream reach being assessed.

Chapter Two: Assessment Methodology and Summary Data

Assessment methodology

SRBC's water quality assessment program is designed to determine whether the waters of the basin meet the water quality standards of the state in which the stream is located. The program also coordinates standards between states to avoid conflicts on interstate streams. The standards are based on protected uses and water quality criteria to prevent stream degradation, as determined by each of SRBC's three state signatory members.

All surface waters in the basin have multiple use designations for aquatic life, water supply, and recreation. Water quality criteria for a specific water body are set to protect the most sensitive use, which generally is aquatic life.

Maryland classifies all of its waters for basic water uses that include water contact recreation (swimming), supporting a balanced population of fish and other aquatic life, supporting wildlife, and providing for water supply (agricultural, industrial). In Pennsylvania, all surface waters

must meet protected uses for aquatic life (warm water fishes), water supply (potable, industrial, livestock, and wildlife), and recreation (boating, fishing, water contact sports, and esthetics). The state of New York has a minimum use requirement that stipulates water quality shall be suitable for primary (swimming) and secondary (fishing) contact recreation. These waters shall be suitable for fish survival, but not necessarily for fish propagation. Each state's water classification and best use definitions are presented in Appendix A.

SRBC's water quality assessment program involves the collection of physical, chemical, and biological data primarily obtained through the interstate water quality network and the subbasin surveys, as described in Chapter One. Data collected from other investigations conducted by SRBC also are included in assessing use support. These data are analyzed relative to the designated use and associated criteria of the water body being assessed. Other information such as land use, location of point sources, and habitat characteristics are incorporated in the assessment as a guide to the possible causes and sources of impairment of a water body. An overall use-support classification for a water body is based upon an integrated assessment of the available data and, when available, the professional judgment of scientists who planned and conducted the field investigations. Assessments based on the collection and analysis of field data are considered to be monitored assessments. Evaluated assessments are based on other information such as maps, general knowledge of area, descriptive reports, state bulletins and registers, and historical water quality data (greater than 5 years) from which a use-support decision is made.

The degree of use support of designated uses is described as full support, partial support, and not supporting. Assessments are based on biological, stream habitat, and/or chemical data collected from SRBC monitoring programs and data from other agencies, when available. The biological and stream habitat condition of a stream segment are assessed using procedures described in Plafkin and others (1989). This method calculates a series of biological and habitat indexes for a stream and compares them to an unimpaired reference station in the same ecoregion. The biological and habitat indexes are assigned to one of four condition categories. For the biological condition, these indexes are nonimpaired, slightly impaired, moderately impaired, and severely impaired, while the habitat indexes are comparable to reference, supporting, partially supporting, and nonsupporting. For water chemistry, the assessment is based on toxicants and conventional pollutants. Acute and chronic water quality standards are used for toxics, and stream designated-use-specific standards are used for the conventional pollutants. When both biological and chemical data are available and the use attainment differs, the degree of use support is weighted to the data most likely to indicate attainment of use. For example, if a one-time grab sample indicates full support, based on biological data, and partial support, based on chemical data, the weight of evidence would be based on the biological data, giving full support. Specific criteria for attainment of use determination are described below.

Biological

Full Support = Nonimpaired biological condition.

Partial Support = Slightly to moderately impaired biological condition.

Not Supporting = Severely impaired biological condition.

Habitat

Full Support = Comparable to reference site.

Partial Support = Supporting to partially supporting habitat.

Not Supporting = Nonsupporting habitat.

Chemistry

Toxics:

Full Support = For at least 10 samples within a 3-year period, zero to one violation of the acute standard for any one parameter per 10 samples, or for the most recent grab sample, no

violation of acute and no more than one parameter exceeding chronic standard.

Partial Support = For at least 10 samples within a 3-year period, two violations of the acute standard for any one parameter per 10 samples, or for the most recent grab sample, one parameter exceeding acute standard and no more than two other parameters ,exceeding chronic standard, or three parameters exceeding the chronic standard.

Not Supporting = For at least 10 samples within a 3-year period, three violations of the acute standard for any one parameter per 10 samples, or for the most recent grab sample, two parameters exceeding acute standard, or more than three other parameters exceeding chronic standard.

Conventional Pollutants:

Full Support = For at least 10 samples within a 3-year period, the standard is exceeded in less than 11 percent of the samples for any one parameter, or for most recent grab sample, no more than one parameter exceeds the respective standard.

Partial Support = For at least 10 samples within a 3-year period, the standard is exceeded in 11 percent to 25 percent of the samples for any one parameter, or for the most recent grab sample, no more than two parameters exceed the respective standards.

Not Supporting = For at least 10 samples within a 3-year period, the standard is exceeded in more than 25 percent of the samples for any one parameter or for the most recent grab sample, three or more parameters exceed the respective standards.

Data gathered to assess the status of the basin's streams are stored in SRBC's water quality assessment database. The summaries generated from the database appear in Appendix B. The database is similar to the US EPA Water Body System (WBS), with respect to producing assessment summaries. However, the design and some attributes differ between the databases. SRBC has no immediate plans to evaluate the feasibility of converting to the WBS format.

Water quality summary

There are approximately 31,193 miles of named streams in the Susquehanna River Basin (US EPA, 1993b), of which 3,519.8 stream miles, or 11 percent, are assessed in this report. Reach-specific data by subbasin are provided in each of the following subbasin summary sections.

Approximately 72 percent of the assessed stream miles meet designated uses (Table 4). This represents 2,524.77 miles of assessed streams.

Partial support of designated uses is reported for 23 percent (820.21 miles) of the assessed stream miles. Partial support is reported when a designated use is marginally restricted, where some degradation of the biological community is observed, or an occasional violation of water quality standards is found during sampling.

Nonsupport of designated uses is reported for 5 percent (174.82 miles) of the assessed stream miles. When attainment of a designated use is limited or not possible—based on direct observation (professional judgment), violation of water quality standards, or a severely degraded biological community—a stream is reported as not supporting designated uses.

The primary causes of stream impairment are from metals and nutrients (Table 5). Acid mine drainage from coal mining is the primary source of metals that is degrading stream reaches in the Susquehanna River Basin (Table 6). Sources of nutrients include municipal and domestic waste discharges and runoff from agricultural areas.

Table 4. Susquehanna River Basin Overall Use Support Summary for Rivers and Streams

Degree of Use Support	Assessment Category		Total Miles Assessed
	Miles Evaluated	Miles Monitored	
Full Support	88.69	2,436.08	2,524.77
Partial Support	8.08	812.13	820.21
Not Supporting	-	174.82	174.82
Total Assessed	**96.77**	**3,423.03**	**3,519.80**

Table 5. Susquehanna River Basin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Causes of Impairment

Cause of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			68.78	40.0
Toxicity				
Pesticides				
Organics			0.5	
Metals	72.6	67.42	21.25	4.7
Ammonia				0.8
Chlorine				3.33
Other Inorganics				15.5
Nutrients	1.0	5.4	231.21	156.55
pH	66.92		28.4	
Siltation	2.5		73.56	7.2
Dissolved Oxygen				3.0
Total Dissolved Solids	5.0	12.5	87.18	45.97
Thermal Modification				
Flow Alteration			3.0	
Habitat Alteration	11.9		118.69	107.8
Pathogen Indicators				
Radiation				
Oil and Grease				
Odor				
Suspended Solids				
Noxious Aquatic Plants				
Filling and Draining				
Sulfate			43.8	

*Major—primary cause of impairment. **Minor—one of multiple causes, but not the predominant cause.

Table 6. Susquehanna River Basin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Sources of Impairment

Source of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			70.06	21.6
Domestic Waste	4.0		2.0	
Industrial Waste	5.0		37.85	60.2
Municipal Waste			17.83	4.13
Other Point Source		2.9	15.7	53.6
Agricultural Runoff	2.5	2.5	345.69	130.72
Urban Runoff	2.9		60.4	30
Other Nonpoint Source				38.3
Acid Precipitation				
Acid Mine Drainage	139.02	71.02	123.55	7
Mining (non-coal)				1
Landfills				
Hydro/Habitat Modification	3.5		60.65	7.3

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

Chapter Three: Rivers and Streams Water Quality Assessment

Chemung Subbasin

The Chemung Subbasin is located in the northwestern portion of the Susquehanna River Basin and drains a watershed of 2,604 square miles (Figure 2). The New York part of the subbasin totals 1,880 square miles, with the remaining area in Pennsylvania. The Chemung River is formed by the confluence of the Tioga River, flowing northward from Pennsylvania, and the Cohocton River, flowing southeast in New York. The Chemung joins the Susquehanna River at Sayre, Pa.

The terrain is typical of glaciated watersheds, and is comprised of rolling to flat-topped uplands with steep-sided alluvial valleys in which the main rivers flow. Forests occupy the steeper hillsides bordering stream valleys, while the flatter hilltops and stream valleys are used for agriculture. Major mineral resources are sand and gravel deposits, located in the alluvial valleys, and coal, which is mined in the headwaters of the Tioga River. Major population centers are the cities of Elmira, Corning, and Hornell.

Designated use support

Over 68 percent of the assessed stream miles meet designated uses (Table 7). This represents approximately 334.8 miles of assessed streams. Partial support of designated uses is reported for 23 percent (112.4 miles) of the assessed miles. Nonsupport of designated uses is reported for 9 percent (44.82 miles) of the assessed miles.

Causes and sources of nonsupport of designated uses

A recent survey of 58 stream sites in the Chemung Subbasin indicated that only 31 percent of the macroinvertebrate communities appeared to be nonimpaired (Traver, 1998). Traver (1998) attributed impaired biological conditions to both water quality and habitat degradation. Poor or altered habitat contributed to half of the impairments, while elevated metal concentrations were found at many of the sites sampled.

The primary causes of stream impairment in the Chemung Subbasin are high metals concentration and low pH problems associated with AMD in the Tioga River. Several tributaries located near the headwaters contribute poor quality water to the Tioga River. Morris Run is the largest source of AMD drainage, with Coal Creek, Bear Run, and Johnson Creek also contributing poor quality water to the Tioga River. Water quality improves in the lower reach of the Tioga River, mainly from the mix of good quality water from Crooked Creek at the Tioga-Hammond dams.

During 1996 and 1997, SRBC monitored the Chemung River at Chemung, N.Y., as well as six interstate tributaries: Cowanesque River; Troups Creek; Tioga River; Seeley Creek; South Creek; and Bentley Creek. Although no biological assessment was made in July 1996, the Chemung River has maintained a slightly to moderately impaired macroinvertebrate population in past surveys. Nutrient enrichment of streams in the Chemung Subbasin, which can adversely affect the biological community, occurs on several tributaries to the Chemung River and along the main stem of the Chemung River. Problems exist downstream of known discharges and also from nonpoint agricultural sources.

Annual rapid bioassessments of the Tioga River at Lindley, N.Y., indicate a nonimpaired biological community for the first time in three years (Rowles and Sitlinger, 1998). Rowles and Sitlinger (1998) reported the Tioga River at Lindley supported a nonimpaired macroinvertebrate population, even though elevated sulfate, nitrates, chlorides and metal concentrations contributed to poor water quality.

The Cowanesque River below Cowanesque Reservoir suffered from a severely degraded macroinvertebrate community in 1997. According to Rowles and Sitlinger (1998), moderately to severely impaired biological conditions have existed for the last

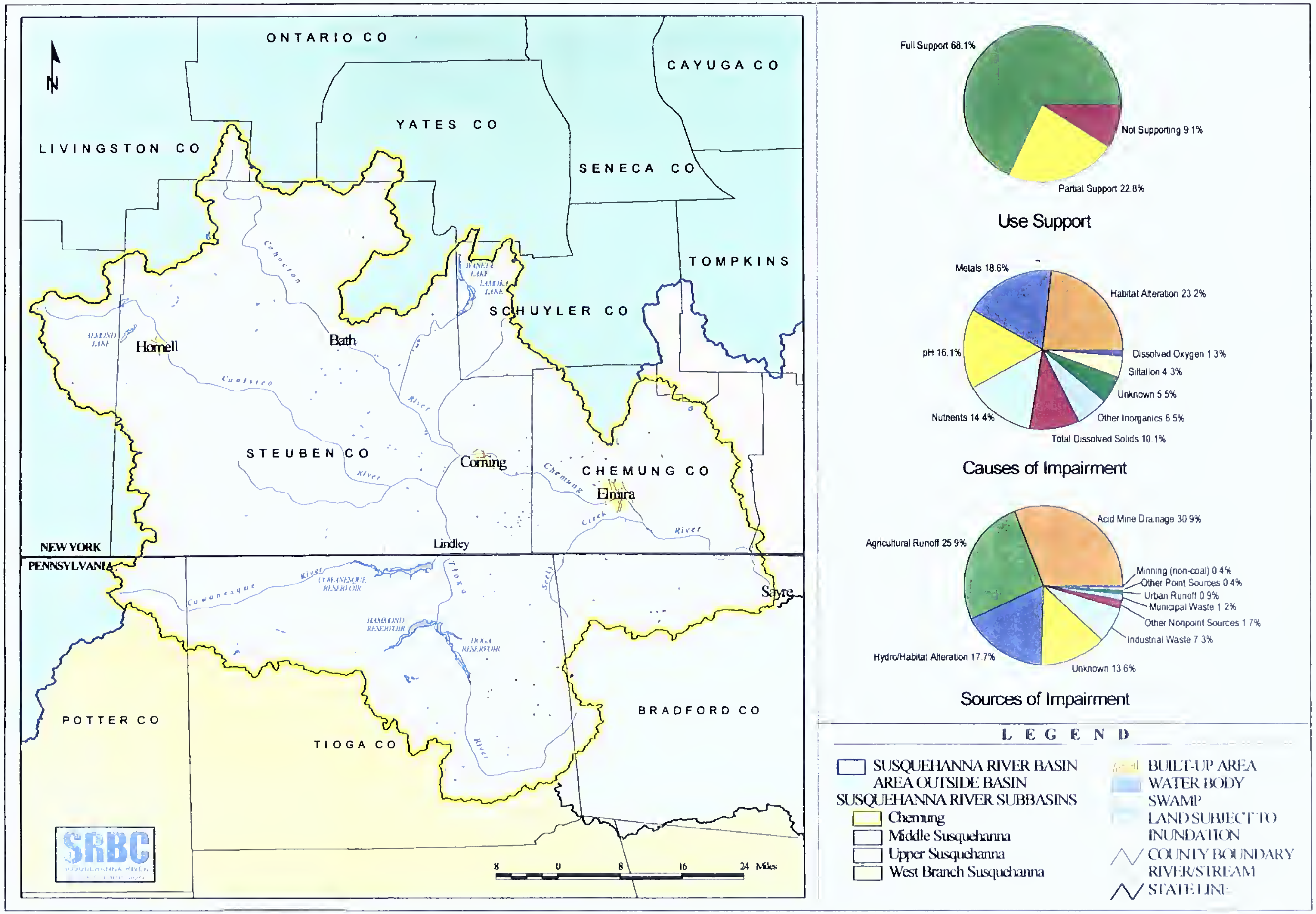

Figure 2. Chemung Subbasin With Stream Use Support, Causes of Stream Impairment, and Sources of Stream Impairment

Table 7. Chemung Subbasin Overall Use Support Summary for Rivers and Streams

Degree of Use Support	Assessment Category		Total Miles Assessed
	Miles Evaluated	Miles Monitored	
Full Support	45.4	289.4	334.8
Partial Support	6.3	106.1	112.4
Not Supporting	-	44.82	44.82
Total Assessed	**51.7**	**440.32**	**492.02**

five years. Water quality samples also indicate that elevated metals, especially iron and manganese, concentrate in Cowanesque Reservoir and are released to the Cowanesque River along with elevated nutrients. Bollinger (1995) attributes the biological impairment to increased phytoplankton production in the reservoir, causing an increase in filter-feeding organisms downstream.

The causes and sources of nonsupport are shown in Tables 8 and 9, respectively.

Table 8. Chemung Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Causes of Impairment

Cause of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			13.1	
Organics				
Metals	0.5	31.42	7.5	4.7
Ammonia				
Chlorine				
Other Inorganics				15.5
Nutrients			26.7	7.5
pH	31.42		6.9	
Siltation			6.3	3.9
Dissolved Oxygen				3.0
Total Dissolved Solids		8.9	9.4	5.8
Flow Alteration				
Habitat Alteration	11.9		38.6	4.6
Sulfate				

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

Table 9. Chemung Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Sources of Impairment

Source of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			20.1	10.5
Domestic Waste				
Industrial Waste				16.5
Municipal Waste			2.8	
Other Point Source			1.0	
Agricultural Runoff			40.3	18
Urban Runoff			1.0	1.0
Other Nonpoint Source				3.9
Acid Mine Drainage	31.42	31.42	6.9	
Mining (non-coal)				1.0
Hydro/Habitat Modification	3.5		34.1	2.3

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

Upper Susquehanna Subbasin

The Upper Susquehanna Subbasin is located in the northeastern portion of the Susquehanna River Basin and drains a watershed of 4,944 square miles, of which 4,520 square miles are in New York (Figure 3). The source of the Susquehanna River is Otsego Lake at Cooperstown, N.Y. From Cooperstown, the river flows southward across Pennsylvania and back into New York at Great Bend, Pa. The Susquehanna River then flows westward to be joined by the Chemung River at Sayre, Pa.

Most of the subbasin is steeply sloped with hills and ridges and dominated by forestland. Agricultural operations occupy the less steep areas. The rural population is dispersed throughout the subbasin. Major population centers are the cities of Binghamton, Johnson City, Endicott, Cortland and Oneonta.

Designated use support

About 97 percent of the assessed stream miles meet designated uses (Table10). This represents 125.66 miles of assessed streams. Partial support of designated uses is reported for 3 percent (4 miles) of the assessed miles. Of the streams assessed, no reach received a nonsupport designated use.

Causes and sources of nonsupport of designated uses

Several reports (NYSDEC, 1989, 1991, 1993, 1994) indicate stream reaches in the Upper Susquehanna Subbasin are experiencing nutrient enrichment and siltation. The combination of steep tributary gradients and glacial deposits makes these areas highly susceptible to erosion. When these areas coincide with agricultural land uses, nutrients and sediments are introduced into streams in the subbasin. Increased siltation of the streambed and eutrophic conditions have reduced habitat used for fish propagation. Of the total stream miles assessed during this reporting period, only four miles of streams did not meet attained uses. The cause is attributed to nutrients. (See Table 11, page 21.)

Sources of nutrients also include discharges from municipal waste systems, especially along the larger streams and rivers. Raw sewage and pathogens from combined sewer overflows and failing on-site systems have been reported along some tributaries and reaches on the Susquehanna, Chenango, Tioughnioga, and Unadilla Rivers (NYSDEC, 1994).

During 1997, SRBC continued its assessment of interstate streams in the Upper Susquehanna Subbasin. The water quality in most of these streams meets designated use classes and water quality standards. The parameter that most frequently exceeded water quality standards was total iron, but these elevated iron concentrations appear to be natural (Rowles and Sitlinger, 1998).

SRBC monitored the Susquehanna River at Windsor and Kirkwood, N.Y., and at Sayre, Pa. Although some constituents were elevated, overall water quality was good at both of these sites. The macroinvertebrate communities in the Susquehanna River at Kirkwood, N.Y., and Sayre, Pa., were slightly impaired and unimpaired, respectively. The Susquehanna River at Windsor, N.Y., served as the reference site, and contained a very healthy macroinvertebrate community (Rowles and Sitlinger, 1998).

Eight tributary streams also were sampled along the New York–Pennsylvania border in the Upper Susquehanna Subbasin. The interstate streams include Cascade, Trowbridge, Snake, Little Snake, Choconut, Apalachin, Wappasening, and Cayuta Creeks. The macroinvertebrate community at all these sites except Choconut Creek, where there was a slightly impaired macroinvertebrate community, was nonimpaired (Rowles and Sitlinger, 1998).

The causes and sources of nonsupport are shown in Tables 11 and 12, respectively.

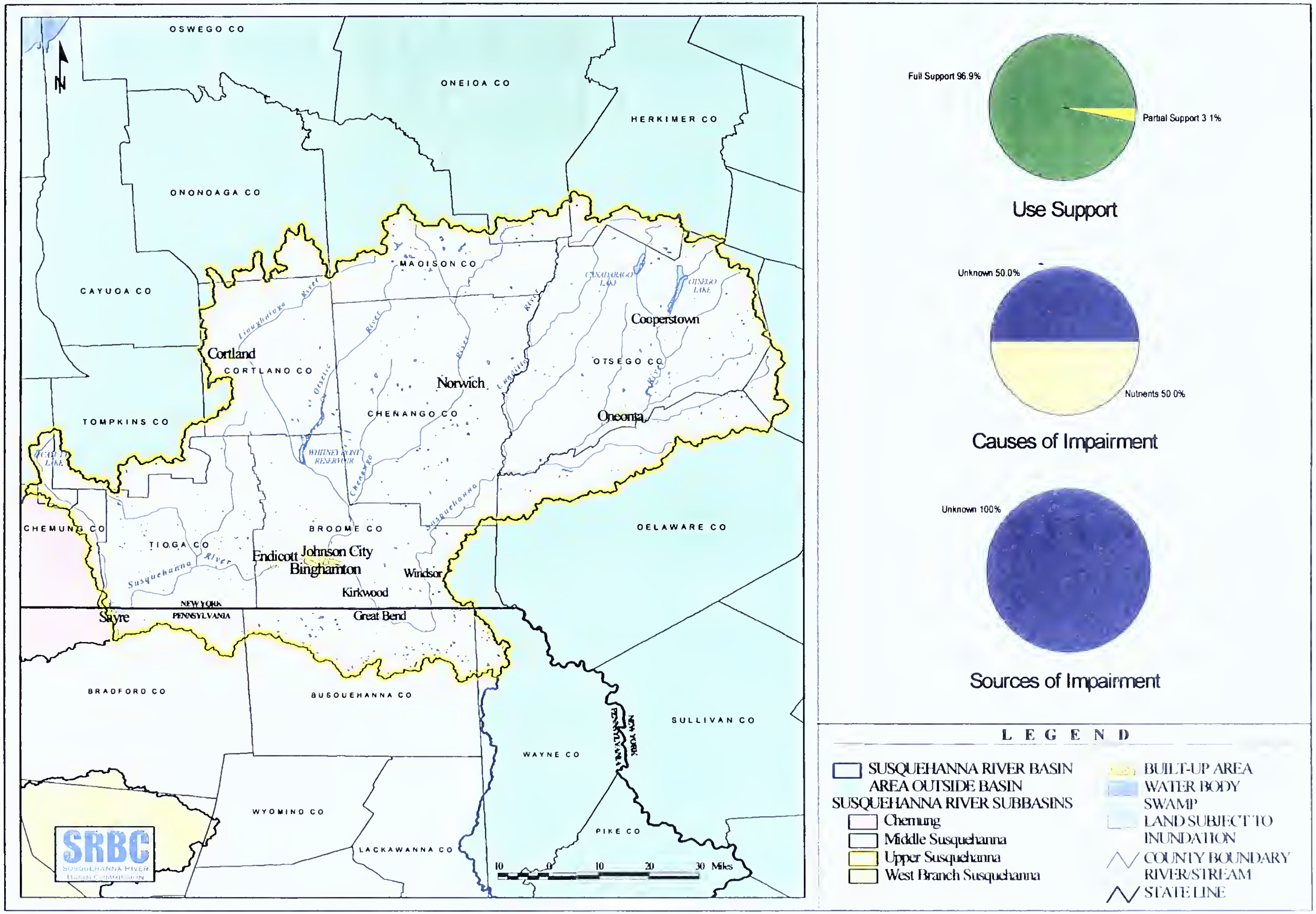

Figure 3. Upper Susquehanna Subbasin With Stream Use Support, Causes of Stream Impairment, and Sources of Stream Impairment

Table 10. Upper Susquehanna Subbasin Overall Use Support Summary for Rivers and Streams

Degree of Use Support	Assessment Category		Total Miles Assessed
	Miles Evaluated	Miles Monitored	
Full Support	-	125.66	125.66
Partial Support	-	4	4
Not Supporting	-	-	-
Total Assessed	-	**129.66**	**129.66**

Table 11. Upper Susquehanna Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Causes of Impairment

Cause of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			4.0	
Organics				
Metals				
Ammonia				
Chlorine				
Other Inorganics				
Nutrients			4.0	
pH				
Siltation				
Dissolved Oxygen				
Total Dissolved Solids				
Flow Alteration				
Habitat Alteration				
Sulfate				

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

Table 12. Upper Susquehanna Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Sources of Impairment

Source of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			4.0	
Domestic Waste				
Industrial Waste				
Municipal Waste				
Other Point Source				
Agricultural Runoff				
Urban Runoff				
Other Nonpoint Source				
Acid Mine Drainage				
Mining (non-coal)				
Hydro/Habitat Modification				

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

Middle Susquehanna Subbasin

The Middle Susquehanna Subbasin covers an area of 3,755 square miles in northeastern Pennsylvania (Figure 4). However, the Susquehanna River at the mouth of the Middle Susquehanna Subbasin drains an area of 11,303 square miles. The river flows southeast through high, flat-topped plateaus separated by steep-sided valleys. Midway, the Susquehanna River joins the Lackawanna River before turning and flowing southwest towards Sunbury, Pa. The terrain in the southern portion of the subbasin consists of northeast-southwest trending ridges and valleys.

The major population center in the subbasin is along what is known as the Wyoming Valley area from Carbondale in the north along the Lackawanna River to Nanticoke in the south along the Susquehanna River. This highly urbanized coal mining region contains the cities of Scranton and Wilkes-Barre.

Designated use support

About 71 percent of the assessed stream miles meet designated uses (Table 13). This represents 505.8 miles of assessed streams. Partial support of designated uses is reported for 21 percent (149.9 miles) of the assessed miles. Nonsupport of designated uses is reported for 8 percent (53.5 miles) of the assessed miles.

Causes and sources of nonsupport of designated uses

A survey of 19 Susquehanna River sites and 56 tributary stream sites in the Middle Susquehanna Subbasin indicated that water quality had a greater impact on biological communities, than on habitat. SRBC (1997) reported that habitat conditions at 83 percent of the sites were rated as either excellent or supporting, with 71 percent of the biological conditions nonimpaired to slightly impaired. Water quality conditions typical of AMD severely impaired biological conditions even though habitat was good to excellent.

Reaches along the Susquehanna River are influenced by a combination of AMD, major point sources, and chemical quality of nearby tributaries. This influence is strongly demonstrated by the Lackawanna River, which divides the Middle Susquehanna Subbasin into two areas based on water quality.

With the exception of a few impaired reaches, the northern part of the subbasin upstream of the mouth of the Lackawanna River has very good water quality and supports a healthy biological community. Most of the tributaries in this part of the subbasin flow through agricultural and forested areas. The reaches that are impaired vary from the effects of agricultural, domestic, municipal, and industrial sources. Malione and others (1984) reported that a few points of localized degradation along the Susquehanna River were quickly assimilated, and good conditions prevailed downstream to the mouth of the Lackawanna River.

In the southern part of the subbasin, the effects of AMD from a once prevalent coal mining industry degrade many stream reaches. Many of the impaired tributaries, including the Lackawanna River, are located in an area known as the Wyoming Valley. This area extends from Scranton, Pa., downstream along the Lackawanna River to Nanticoke, Pa., on the Susquehanna River. The most obvious impact on water quality is from AMD and is evident immediately downstream of the Lackawanna River, where a red-orange precipitate coats the Susquehanna River channel along the east bank for several miles (Malione and others, 1984). The impact of this major urban population center on the tributaries is caused by storm water runoff and sewage in the streams, along with trash and debris in the streambeds.

Downstream of the Wyoming Valley, the water quality of the Susquehanna River improves. Most of the tributaries along this reach are characteristic of the streams in the northern part of the subbasin, contributing good quality water. The major source of degradation is impairment from AMD, primarily in Catawissa, Black, and Little Nescopeck Creeks.

The causes and sources of nonsupport are shown in Tables 14 and 15, respectively.

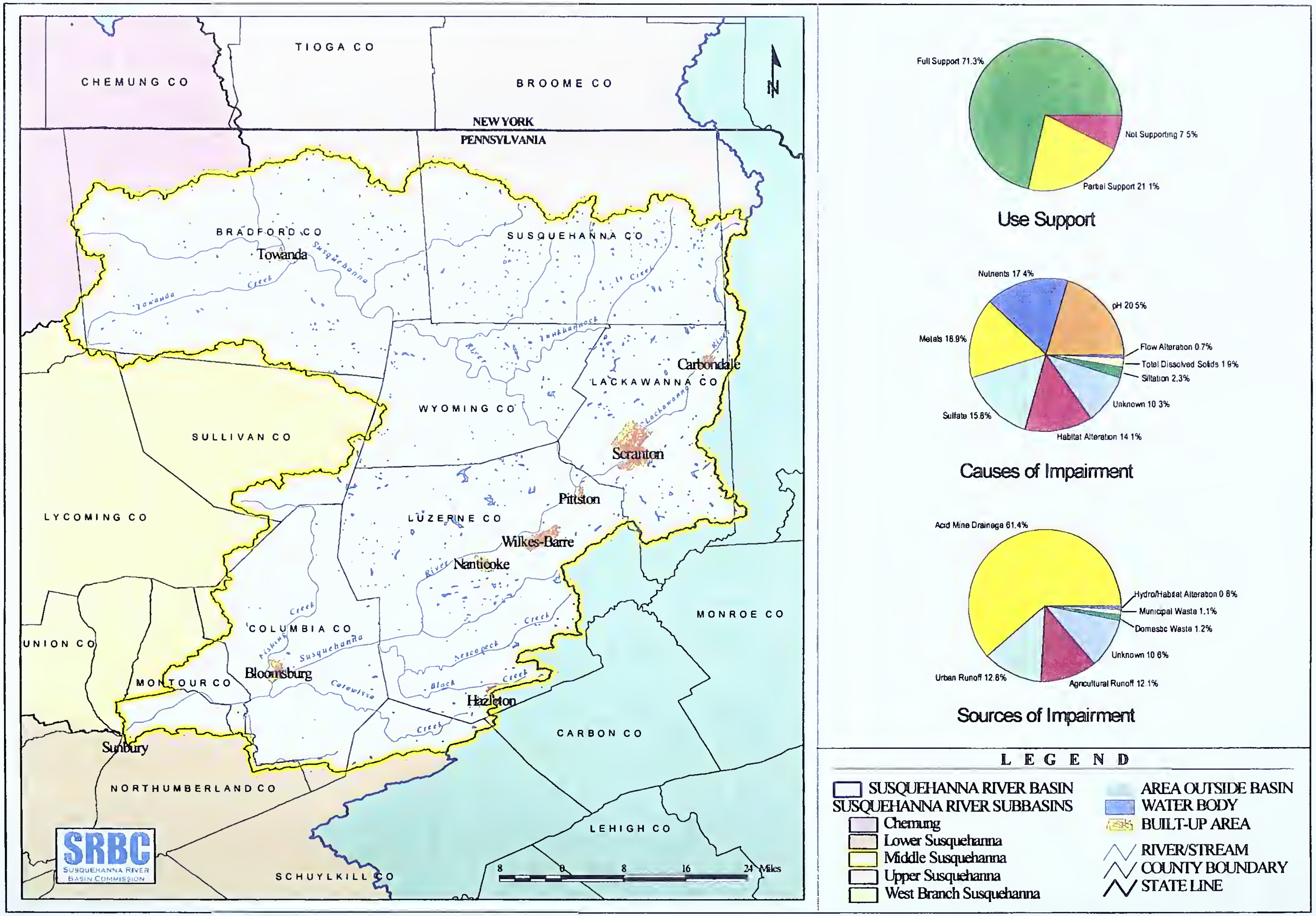

Figure 4. Middle Susquehanna Subbasin With Stream Use Support, Causes of Stream Impairment, and Sources of Stream Impairment

Table 13. Middle Susquehanna Subbasin Overall Use Support Summary for Rivers and Streams

Degree of Use Support	Assessment Category		Total Miles Assessed
	Miles Evaluated	Miles Monitored	
Full Support	24.4	501.4	505.8
Partial Support	-	149.9	149.9
Not Supporting	-	53.5	53.5
Total Assessed	**24.4**	**704.8**	**709.2**

Table 14. Middle Susquehanna Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Causes of Impairment

Cause of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			23.0	5.6
Organics				
Metals	11.0	36.0		
Ammonia				
Chlorine				
Other Inorganics				
Nutrients	1.0		4.4	43.0
pH	35.5		21.5	
Siltation			3.0	3.3
Dissolved Oxygen				
Total Dissolved Solids		3.6	1.6	
Flow Alteration			2.0	
Habitat Alteration			10.0	29.2
Sulfate			43.8	

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

Table 15. Middle Susquehanna Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Sources of Impairment

Source of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			20.5	5.6
Domestic Waste	1.0		2.0	
Industrial Waste				
Municipal Waste			2.6	
Other Point Source				
Agricultural Runoff			14.8	5.0
Urban Runoff			4.1	27.5
Other Nonpoint Source				
Acid Mine Drainage	46.5	39.6	21.5	43.8
Mining (non-coal)				
Hydro/Habitat Modification			2.0	

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

West Branch Susquehanna Subbasin

The West Branch Susquehanna River drains 6,992 square miles of the western and central part of the Susquehanna River Basin (Figure 5). Originating in the low rolling hills of the Allegheny Mountains in Pennsylvania, the West Branch flows northeast passing the steep hillsides of the Allegheny High Plateaus Section. At Renovo, the West Branch turns southeast and cuts through the Allegheny Front, entering a region of broad valleys separated by long, high ridges. Following the northern flank of Bald Eagle Mountain northeastward, the West Branch turns south to its confluence with the Susquehanna River near Sunbury.

The subbasin is covered predominantly by forests, especially in the northern and western ends of the subbasin where land is less suitable for agriculture. Extensive coal mining is the major land use activity in the western parts of the subbasin. Agricultural and urban lands primarily are located in the eastern and southern parts of the subbasin. Larger communities include State College, Lock Haven, Williamsport, Clearfield, and Lewisburg.

Designated use support

Streams in the West Branch Susquehanna Subbasin were not assessed for designated use support during this reporting period.

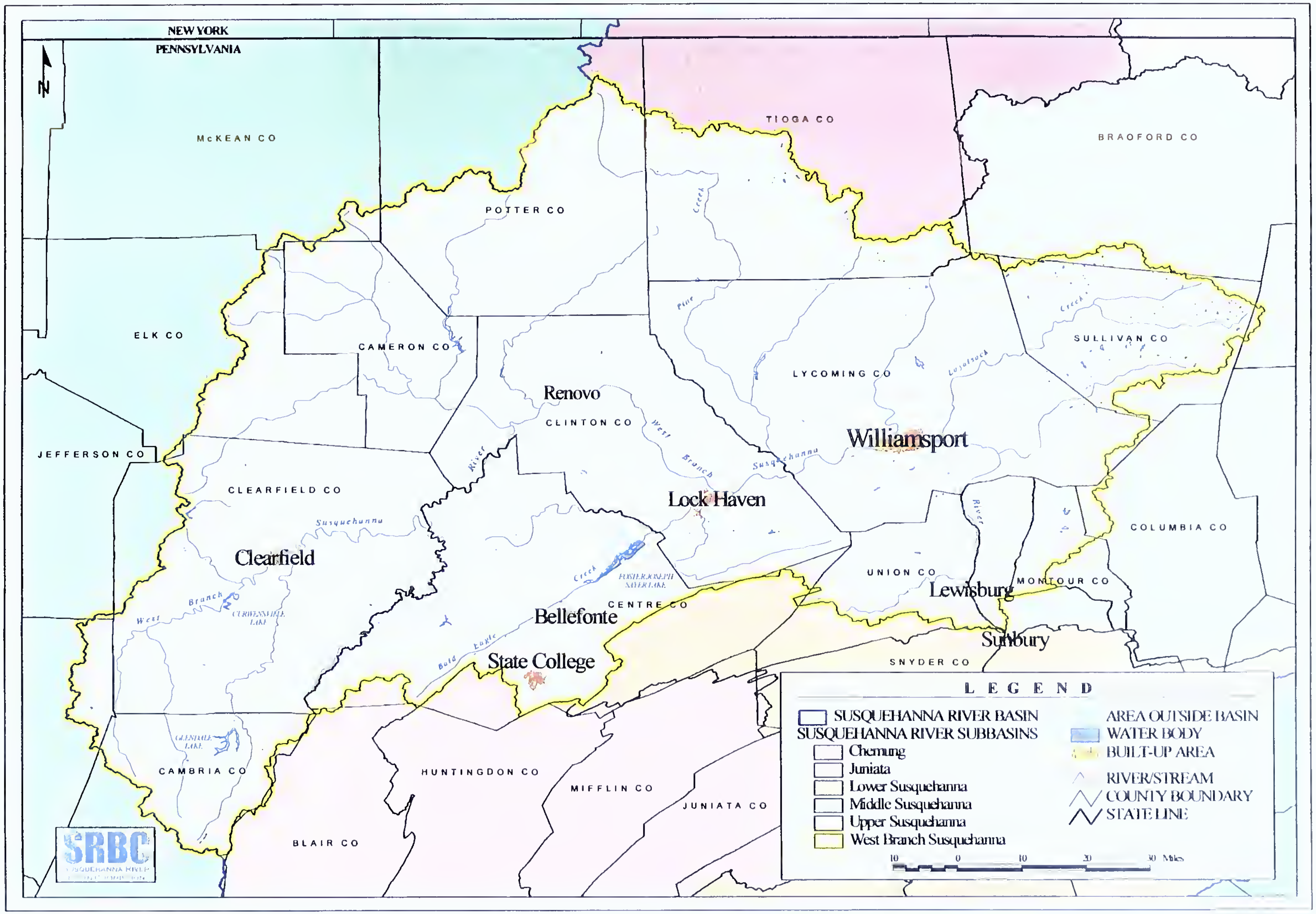

Figure 5. West Branch Susquehanna Subbasin

Juniata Subbasin

The Juniata River drains an area of 3,406 square miles in south central Pennsylvania and is the second largest tributary to the Susquehanna River (Figure 6). The Juniata River is formed by the confluence of the Little Juniata River and the Frankstown Branch Juniata River. The Juniata Subbasin is entirely within the Valley and Ridge Physiographic Province, which is characterized by a series of tightly-folded parallel mountains and long, narrow valleys. Major streams run through the center of valleys, picking up flow from small tributaries from the flanks of mountains.

Farming, the predominant economic activity, is scattered throughout the valleys, while the steep mountain ridges are forested. The subbasin population is largely rural, with the Altoona-Hollidaysburg area being the only sizable urban center. Other small towns include Tyrone, Huntingdon, Lewistown, and Newport.

Designated use support

Over 73 percent of the assessed stream miles meet designated uses (Table 16). This represents 495.86 miles of assessed streams. Partial support of designated uses is reported for 26 percent (173.5 miles) of the assessed miles. Nonsupport of designated uses is reported for 1 percent (6.0 miles) of the assessed miles.

Causes and sources of nonsupport of designated uses

The Juniata River supports healthy biological communities and has good quality water throughout its length. Likewise, most of the streams in the Juniata Subbasin have good to excellent water quality. However, water pollution problems do occur in a few stream reaches due to municipal and industrial sources. The Frankstown Branch Juniata River suffers degradation from paper mill discharges. The lower reach of Kishacoquillas Creek and the Beaverdam Branch Juniata River show impairment from industrial and municipal discharges. This condition, however, is expected to improve as municipal systems are upgraded.

McGarrell (1997b) reported that over half of the 59 sites investigated in the Juniata Subbasin supported nonimpaired biological communities. McGarrell stated that several stream reaches described as having highly depressed water quality and biological conditions in the late 1970s had improved dramatically, while some of the stream reaches were still moderately impaired.

The causes and sources of nonsupport are shown in Tables 17 and 18, respectively.

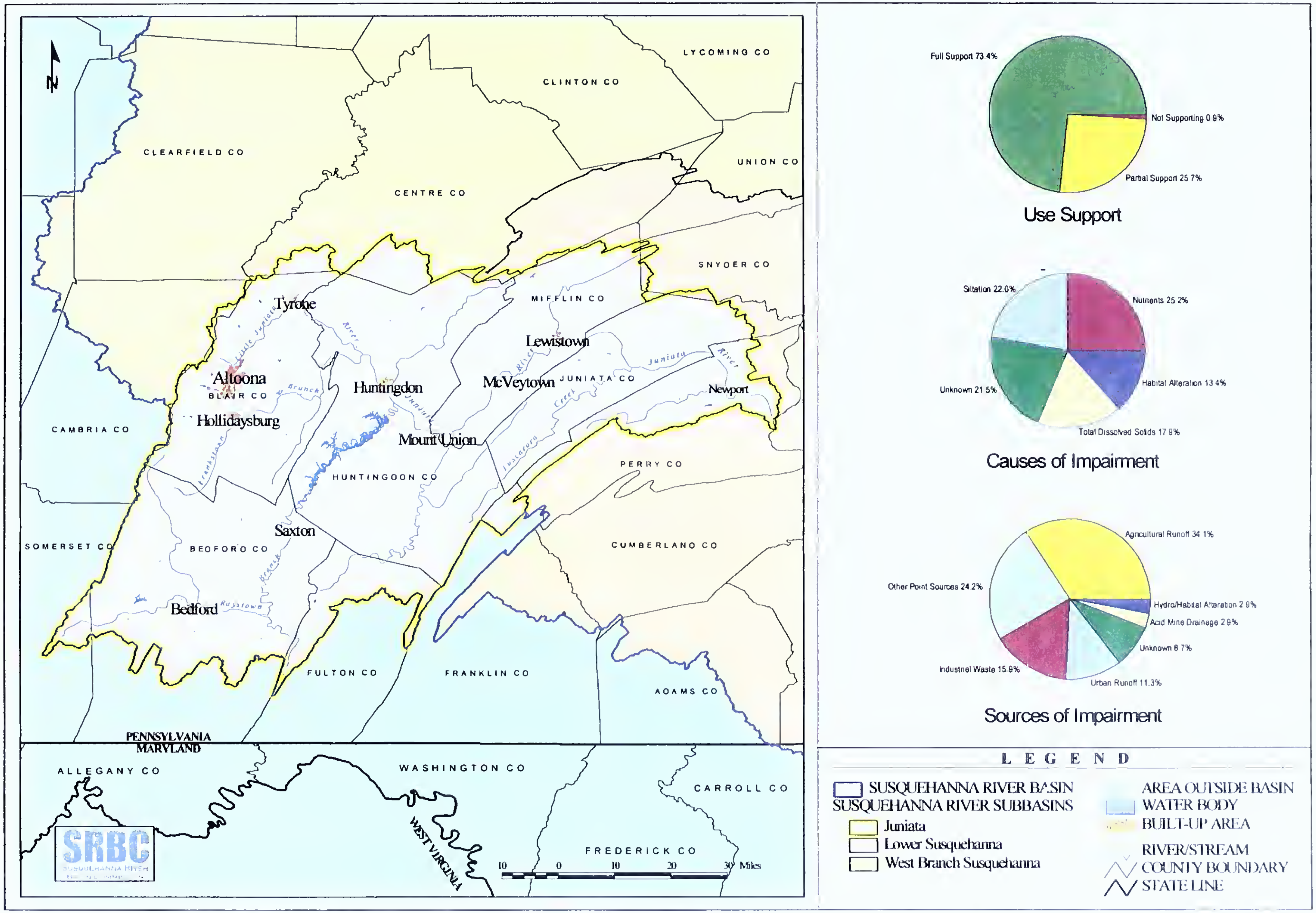

Figure 6. Juniata Subbasin With Stream Use Support, Causes of Stream Impairment, and Sources of Stream Impairment

Table 16. Juniata Subbasin Overall Use Support Summary for Rivers and Streams

Degree of Use Support	Assessment Category		Total Miles Assessed
	Miles Evaluated	Miles Monitored	
Full Support	12.5	483.36	495.86
Partial Support	-	173.5	173.5
Not Supporting	-	6.0	6.0
Total Assessed	**12.5**	**662.86**	**675.36**

Table 17. Juniata Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Causes of Impairment

Cause of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			21.8	21.4
Organics				
Metals				
Ammonia				
Chlorine				
Other Inorganics				
Nutrients		2.5	16.0	32.1
pH				
Siltation	2.5		41.6	
Dissolved Oxygen				
Total Dissolved Solids	1.0		34.85	
Flow Alteration				
Habitat Alteration			7.0	20.0
Sulfate				

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

Table 18. Juniata Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Sources of Impairment

Source of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			17.8	
Domestic Waste				
Industrial Waste	1.0		16.85	14.7
Municipal Waste			0.1	
Other Point Source			14.7	34.9
Agricultural Runoff	2.5	2.5	42.5	22.5
Urban Runoff			23.3	
Other Nonpoint Source				
Acid Mine Drainage				6.0
Mining (non-coal)				
Hydro/Habitat Modification			6.0	

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause

Lower Susquehanna Subbasin

The Lower Susquehanna Subbasin is located in south central Pennsylvania, and covers an area of 5,809 square miles, of which 275 square miles are in Maryland (Figure 7). The northern part of the subbasin contains ridges trending southwest to northeast and valleys of moderate width. The Susquehanna River cuts through this series of ridges and widens as it flows south to southeast through rolling hills and ,broad valleys of the central part of the subbasin. The southern part of the subbasin is characterized by metamorphosed sediments that have been intensely folded and faulted. This material caused the river to carve a deep gorge into the bedrock in a narrowing river valley. The Susquehanna River flows into the Chesapeake Bay at Havre de Grace, Md., providing over 50 percent of the freshwater inflow to the bay.

Of the six subbasins in the Susquehanna River Basin, the Lower Susquehanna Subbasin is the most developed. The steep river slope and narrow valley of the lower Susquehanna gorge provide areas for hydropower development. This part of the subbasin is a major production area for electricity (McMorran, 1986b). Some of the most productive agricultural lands and largest population centers of the Susquehanna River Basin are located in the Lower Susquehanna Subbasin. Intense agricultural development occurs in many of the fertile limestone-type soils throughout the subbasin. A significant population is employed in government-related activities around Harrisburg, Pennsylvania's capital. Other major population and industrial centers are Lancaster, York, Lebanon, and Carlisle.

Designated use support

About 70 percent of the assessed stream miles meet designated uses (Table 19). This represents 1062.65 miles of assessed streams. Partial support of designated uses is reported for 25 percent (380.41 miles) of the assessed miles. Nonsupport of designated uses is reported for 5 percent (70.5 miles) of the assessed miles.

Causes and sources of nonsupport of designated uses

Traver (1997) investigated the condition of the biological community, physical habitat, and chemical water quality of 96 stream sites in the Lower Susquehanna Subbasin. Traver concluded that 49 percent of the streams surveyed displayed slight biological impairment. Biological conditions reported by Traver (1997) are similar to those documented by McMorran (1986) and Brezina (1980), with improvements occurring in some of the AMD-impaired streams. AMD and agricultural sources are responsible for the majority of impaired stream reaches in the Lower Susquehanna Subbasin.

The AMD impaired streams are primarily located in the northern part of the subbasin. These streams are characterized by low pH and high dissolved metals concentrations, severely reducing aquatic life. Shamokin and Mahanoy Creeks are severely impaired from the source to the mouth. Tributary streams in the upper Swatara Creek also are impaired by AMD, but the Swatara Creek recovers as it flows downstream, receiving good quality water from tributaries along the lower reach. Stoe (1998) reported AMD impacts of Wiconisco Creek from discharges from the Porter Mine Tunnel and stip mine areas of the Bear Creek Watershed.

Agricultural sources are responsible for the majority of the impaired reaches in the southern part of the subbasin, where some of the most highly productive agricultural lands in the Susquehanna River Basin are located. Agricultural runoff and livestock in streams commonly cause increased levels of nutrients, siltation, and turbidity. These problems are of interest to Chesapeake Bay Program goals related to reducing nutrient transport.

The causes and sources of nonsupport are shown in Tables 20 and 21, respectively.

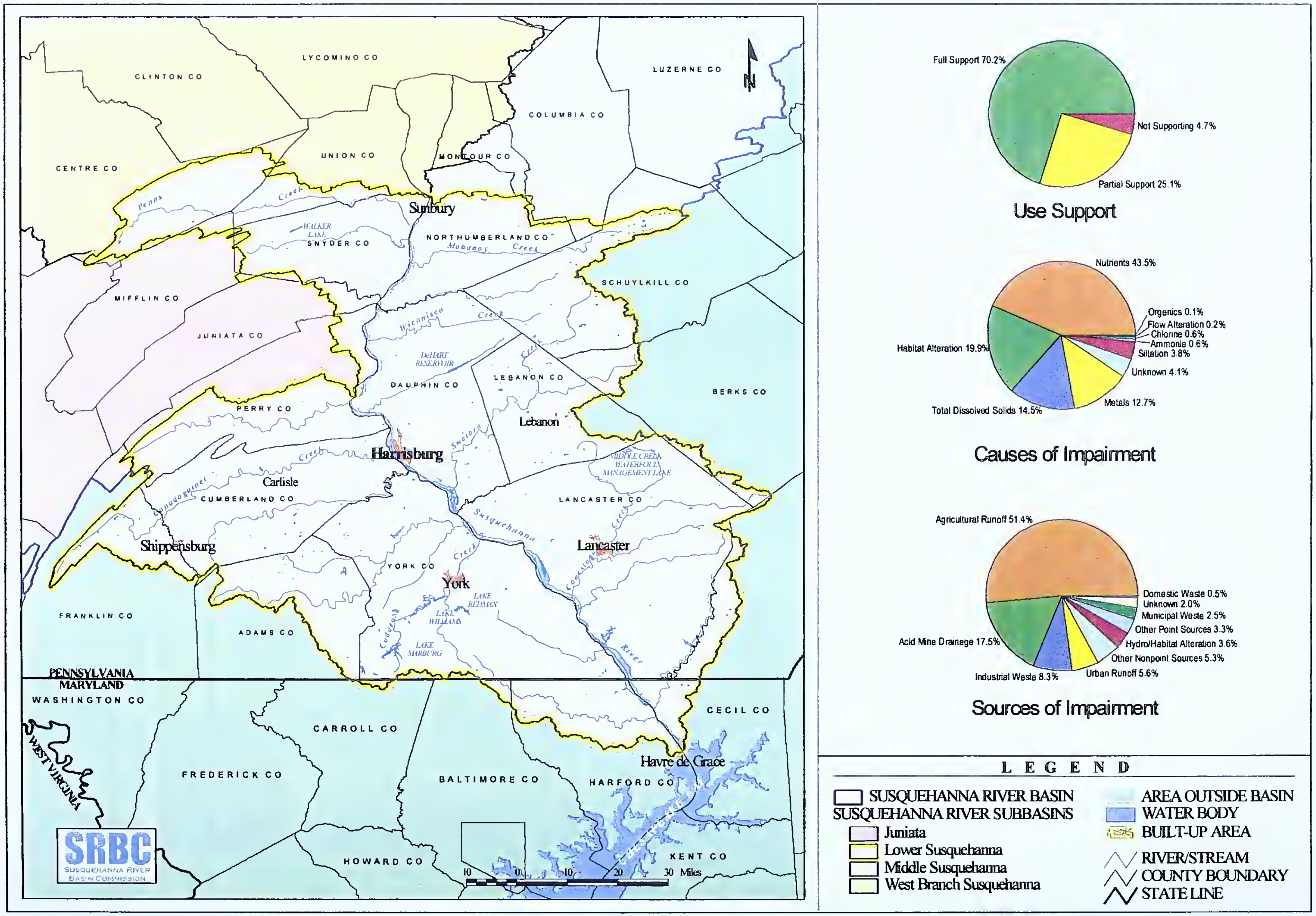

Figure 7. Lower Susquehanna Subbasin With Stream Use Support, Causes of Stream Impairment, and Sources of Stream Impairment

Table 19. Lower Susquehanna Subbasin Overall Use Support Summary for Rivers and Streams

Degree of Use Support	Assessment Category		Total Miles Assessed
	Miles Evaluated	Miles Monitored	
Full Support	6.39	1056.26	1062.65
Partial Support	1.78	378.63	380.41
Not Supporting	-	70.5	70.5
Total Assessed	**8.17**	**1505.39**	**1513.56**

Table 20. Lower Susquehanna Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Causes of Impairment

Cause of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			10.88	13.0
Organics			0.5	
Metals	61.1		13.75	
Ammonia	3.0			0.8
Chlorine				3.33
Other Inorganics				
Nutrients		2.9	180.11	73.15
pH				
Siltation			22.66	
Dissolved Oxygen				
Total Dissolved Solids	4.0		41.33	40.17
Flow Alteration			1.0	
Habitat Alteration			63.09	54.0
Sulfate				

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

Table 21. Lower Susquehanna Subbasin Total Stream Miles Not Supporting and Partially Supporting Uses by Various Sources of Impairment

Source of Impairment	Total Length of Waters Affected (in miles)			
	Not Supporting		Partial Support	
	Major*	Minor**	Major*	Minor**
Unknown			7.66	5.5
Domestic Waste	3.0			
Industrial Waste	4.0		21.0	29.0
Municipal Waste			12.33	4.13
Other Point Source		2.9		18.7
Agricultural Runoff			248.09	85.22
Urban Runoff	2.9		31.64	1.5
Other Nonpoint Source				34.4
Acid Mine Drainage	61.1		51.35	1.0
Mining (non-coal)				
Hydro/Habitat Modification			18.55	5.0

*Major—primary source of impairment. **Minor—one of multiple sources, but not the predominant cause.

Chapter Four: Lake Water Quality Assessment

According to US EPA's (1993b) Total Waters Database and Reporting Program, the Susquehanna River Basin has a total of 2,293 lakes, reservoirs, and ponds totaling 79,687 acres.

During past 305(b) reporting cycles, SRBC conducted a 2-year project, funded by US EPA and Pennsylvania Department of Environmental Protection (Pa. DEP) through the Section 314(a) Clean Lakes Program. The purpose of the project was to: (1) update the Pa. DEP's database for lakes and water quality of lakes; (2) enhance the Water Quality Assessment reporting activities under Section 305(b); and (3) help evaluate and prioritize projects funded under the Section 314 Clean Lakes Program. SRBC's inventory of lakes in the Pennsylvania part of the Susquehanna River Basin identified 135 lakes with public access, of which 70 were considered significant (Ballaron and others, 1996). The trophic state of ten lakes in the Susquehanna River Basin was reported in the 1996 305b report (Edwards, 1996).

Chapter Five: Estuary and Coastal Assessment

Not applicable.

Chapter Six: Wetlands Assessment

SRBC has not conducted any assessment work on wetlands in the basin.

Chapter Seven: Public Health/Aquatic Life Concerns

Toxics in the nation's waters and their impact on human and aquatic health have been of increasing concern to federal and state agencies. These pollutants enter the water environment from point sources such as industrial facilities and sewage treatment plants and nonpoint sources such as agricultural and urban runoff, atmospheric deposition, rock and soil weathering, and erosion.

SRBC's role in addressing toxic pollution is to support state and federal programs. The commission assists other agencies in data collection for the overall goals of the Chesapeake Bay Program and Pa. DEP's Priority Water Body Surveys. No SRBC programs are directed specifically at toxic substances in lakes or freshwater wetlands.

PART IV: GROUND-WATER ASSESSMENT

Overview

The commission obtains ground-water quality information through ground-water withdrawal permits, investigations, cooperative studies, and surveys pertaining to existing ground-water quality or probable future ground-water quality in the basin. One series of reports (Taylor, 1984, 1988; Taylor and Werkheiser, 1984; Taylor and others, 1982, 1983) evaluated the ground-water quantity and quality characteristics of the Susquehanna River Basin.

The authors found the most commonly-reported ground-water quality problems in the basin are excessive iron and manganese, hydrogen sulfide, hardness, bacterial organisms from sewage, AMD, excessive nitrates, petroleum products from underground storage tanks, chlorinated solvents from degreasing operations, and landfill leachate. Most of the man-induced problems are localized and confined to a small number of wells. The localized problems could be eliminated if wells were constructed with deeper casing and the annular openings were tightly sealed.

In the Chemung and Upper Susquehanna Subbasins, the most common, naturally occurring constituents in excessive amounts are iron, manganese, chloride, sodium, and barium. Analyses from some wells indicate the presence of natural and hydrogen sulfide gas. Contamination from AMD is a problem in the southern part of the Chemung Subbasin.

The primary aquifers of the two northern subbasins are stratified drift deposits found in the major valleys. Most human-use development is located in these major valleys atop the primary aquifers, making ground water highly vulnerable to contamination.

Several significant coal-bearing units are located in the West Branch Susquehanna Subbasin. The natural ground-water quality from some wells sampled exhibited elevated amounts of iron, sulfate, and dissolved solids, which also are the same characteristics of ground water contaminated by AMD. Because of the similarity in water quality from AMD contamination and natural conditions, documentation of acid-mine-polluted ground water is difficult to determine.

The ground-water quality of the Middle Susquehanna Subbasin is similar to ground-water quality in many of the other subbasins. The glaciated water quality of the terrain in the northern part of the subbasin is similar to the water quality of the Chemung and Upper Susquehanna Subbasins. Significant anthracite-bearing units and associated mining activities in the Lackawanna River valley have resulted in water quality similar to that of the West Branch Susquehanna Subbasin.

In the Juniata Subbasin, the greatest differences in water quality occurred between calcareous and noncalcareous rock units. The highest concentrations of iron were in the noncalcareous units and coal-bearing units. The only significant coal-bearing units in the Juniata Subbasin occur in the Broad Top coal field of Bedford, Fulton, and Huntingdon Counties, where land has been disturbed by surface and deep mining operations. Of the 164 water samples taken during the study (Taylor and others, 1982), 13 percent of the water samples showed ground-water quality that had been seriously degraded by acid mine water (high iron, manganese, sulfate, and low pH).

Taylor and Werkheiser (1984) analyzed 369 samples obtained from wells and springs to evaluate the ground-water quality of the Lower Susquehanna Subbasin. The major difference in regional quality occurs between rock units that are calcareous, as compared to noncalcareous. Constituents consistently present in greater concentrations in the calcareous units are calcium, dissolved solids, magnesium, and nitrate.

Susquehanna River Basin Commission Ground-Water Program

SRBC's ground-water program deals with water quantity as set forth in SRBC's "Regulations and Procedures for Review of Projects," Section 803.43, regulating ground-water withdrawals. Anyone proposing to withdraw ground water from a single well or well field in excess of an average of 100,000 gallons per day (gpd) for any consecutive 30-day period must obtain commission approval of the withdrawal. As part of the regulation, samples of ground water for water quality analysis must be obtained, and results reported to the commission every three years.

Ground-water monitoring is necessary to ensure ground-water withdrawals and sources of ground-water contamination do not endanger the quantity and quality of the ground-water resource. Ground-water quality contamination from on-lot septic systems and agricultural pollution are of concern to SRBC and are identified in the Ground-Water Management Plan (1993).

Many domestic wells are located in subdivisions that utilize on-lot septic systems. In the absence of controls on well location and lot size, problems related to well interference and ground-water contamination from on-lot systems frequently occur.

Agricultural nonpoint source contamination of ground water, principally from nitrate and pesticides, has received considerable attention recently. However, limited attention is given to the fact that many of the receiving streams of point sources are influent during parts of the year, and thus are sources of ground-water recharge and potential contamination. The geologic areas of concern are those underlain by carbonate rocks and those having thick deposits of glacial outwash.

PART V: WATER POLLUTION CONTROL PROGRAM

The Susquehanna River Basin Compact recognizes that the states shall have the primary responsibility for water quality management and control. Therefore, SRBC plays a regional role in attempting to coordinate local, state, and federal water quality management efforts, promote uniform enforcement of, and compliance with, established standards and classifications, and encourage amendment and modification of standards and classifications within the basin, as deemed in the public interest.

SRBC's program objective is to control water pollution sufficiently to maintain and establish water quality capable of supporting multiple purpose uses for: public water supply after treatment; recreation, fish and wildlife; agriculture; industry; and other such uses. To meet that objective, the overall goal is to achieve compliance with water quality standards and criteria for intrastate and interstate waters of the basin, as established by the signatory parties.

Chapter One: Point Source Control Program

SRBC's point source control program goal is to encourage continued upgrading and development of needed public and private waste treatment facilities. SRBC reviews proposed discharge permits and provides comments to permitting agencies on matters within SRBC jurisdiction. Reviews are oriented towards evaluating potential interstate or regional impacts.

Chapter Two: Nonpoint Source Control Program

SRBC's nonpoint source program goal is the increased control of stormwater runoff and nonpoint source pollution through the fulfillment of the objectives of the Chesapeake Bay Program. These objectives are related to monitoring and research recommendations, baywide nutrient recommendations, and baywide toxicant recommendations.

Chapter Three: Cost/Benefit Analysis

Not performed.

Chapter Four: Special State Concerns and Recommendations

Acid mine drainage

Degradation of streams due to AMD from past coal mining activities is the most prevalent water quality problem in the basin. These discharges occur when coal and sulfur-bearing minerals (pyrite) are exposed to oxidizing conditions to form sulfuric acid. The low pH of the water also dissolves metals (iron, manganese, and aluminum) from the rock strata. These dissolved metals can enter nearby streams.

State and federal agencies are pursuing remedial action for this problem, but progress is slow due to the magnitude of the problem and the significant costs to clean up the degradation. Successful abatement projects have been implemented in small areas, but the scope of the problem is so large, it will take many years before streams affected by AMD meet designated uses.

Chesapeake Bay

Chesapeake Bay Program findings indicate the Susquehanna River Basin contributes the major portion of nutrients and a significant portion of toxics to the bay. To create a water quality condition necessary to support the living resources of the bay, the Chesapeake Bay Program states have agreed to reduce or control point and nonpoint sources of pollution. Programs and policies implemented by bay states to reduce nutrient and toxic transport to the bay have produced water quality benefits in the Susquehanna River Basin. Future efforts should focus on a continued commitment to the reduction of nutrients and an expanded commitment to reducing toxics and conventional pollutants.

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Appendix A
Water Classification and Best Usage Relationships

NEW YORK:

The New York State water quality classifications are summarized from Water Quality Regulations for Surface Waters and Groundwaters, 6NYCRR Parts 700-705 Effective September 1, 1991. NYSDEC Division of Water, Albany, N.Y.

Class AA - The best usages of Class AA waters are a source of water supply for drinking, culinary, or food processing purposes; primary and secondary contact recreation; and fishing. The waters shall be suitable for fish propagation and survival. This classification may be given to those waters that, if subjected to approved disinfection treatment, with additional treatment necessary to remove naturally present impurities, meet or will meet New York State Department of Health drinking water standards and are or will be considered safe and satisfactory for drinking water purposes.

Class A - The best usages of Class A waters are a source of water supply for drinking, culinary, or food processing purposes; primary and secondary contact recreation; and fishing. The waters shall be suitable for fish propagation and survival. This classification may be given to those waters that, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment necessary to remove naturally present impurities, meet or will meet New York State Department of Health drinking water standards and are or will be considered safe and satisfactory for drinking water purposes.

Class B - The best usages of Class B waters are primary and secondary contact recreation and fishing. These waters shall be suitable for fish propagation and survival.

Class C - The best usage of Class C waters is fishing. These waters shall be suitable for fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

Class D - The best usage of these waters is fishing. Due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or streambed conditions, the waters will not support fish propagation. These waters shall be suitable for fish survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

(T) - Suffix added to Classes AA, A, B, C where trout survival is an additional best use to the use classification.

(TS) - Suffix added to Classes AA, A, B, C where trout propagation is an additional best use to the use classification.

PENNSYLVANIA:

The Pennsylvania State water quality classifications are summarized from Water Quality Standards of the Department's Rules and Regulations, 25 Pa. Code, Chapter 93.3-5, effective August 1989, Pa. DER, Division of Water Quality, Harrisburg, Pa. All surface waters must meet protected water uses for aquatic life (warm water fishes), water supply (potable, industrial, livestock, and wildlife), and recreation (boating, fishing, water contact sports, and esthetics). The classification of uses are as follows:

EV - Exceptional Value Waters: These waters must meet the statewide list, and are protected at their existing water quality. These streams constitute outstanding national, state, regional, or local resources. The water quality in these streams shall not be lowered.

HQ-TSF - High Quality Trout Stocking Fishery: The water quality can only be lowered if a discharge is the result of necessary social or economic development, the water quality criteria are met, and all existing uses are protected. Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna, which are indigenous to a warm water habitat.

HQ-CWF - High Quality Cold Water Fishery: The water quality can only be lowered if a discharge is the result of necessary social or economic development, the water quality criteria are met, and all existing uses are protected. Maintenance and/or propagation of fish species, including the family of Salmonidae and additional flora and fauna, which are indigenous to a cold water habitat.

HQ-WWF - High Quality Warm Water Fishery: The water quality can only be lowered if a discharge is the result of necessary social or economic development, the water quality criteria are met, and all existing uses are protected. Maintenance and propagation of fish species and additional flora and fauna, which are indigenous to a warm water habitat.

TSF - Trout Stocked Fishery: Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna that are indigenous to a warm water habitat.

CWF - Cold Water Fishery: Maintenance and/or propagation of fish species, including the family Salmonidae and additional flora and fauna, which are indigenous to a cold water habitat.

WWF - Warm Water Fishery: Maintenance and propagation of fish species and additional flora and fauna that are indigenous to a warm water habitat.

MF - Migratory Fishes: Passage, maintenance and propagation of anadromous and catadromous fishes and other fishes that ascend to flowing waters to complete their life cycle. The MF designation is in addition to other designations when appropriate.

MARYLAND

The Maryland State water quality classifications are summarized from Water Quality Regulations for Designated Uses, COMAR 26.08.02, Effective November 1, 1993, Maryland Department of the Environment, Annapolis, Md. All surface waters must protect public health or welfare; enhance the quality of water; protect aquatic resources; and serve the purposes of the Federal Act. The designated uses are:

USE I - Water Contact Recreation, and Protection of Aquatic Life. This use designation includes waters that are suitable for water contact sports; play and leisure time activities where individuals may come in direct contact with surface water; fishing; the growth and propagation of fish (other than trout), other aquatic life, and wild life; and industrial supply.

USE I-P - Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply. This use includes all uses identified in USE I; and use as a public water supply.

USE II - Shellfish Harvesting Waters. This use designation includes waters where shellfish are propagated, stored, or gathered for marketing purposes; and actual or potential areas for the harvesting of oysters, softshell clams, hardshell clams, and brackish water clams.

USE III - Natural Trout Waters. This use designation includes waters that have the potential for or are suitable for the growth and propagation of trout; and capable of supporting self-sustaining trout populations and their food organisms.

USE III-P - Natural Trout Waters and Public Water Supply. This use includes all uses identified in USE III; and use as a public water supply.

USE IV - Recreational Trout Waters. This use designation includes cold or warm waters which have the potential for or are capable of holding or supporting adult trout for put-and-take fishing; and managed as a special fishery by periodic stocking and seasonal catching.

USE IV-P - Recreational Trout Waters and Public Water Supply. This use includes all uses identified in USE IV; and use as a public water supply.

Appendix B
Assessed Stream Reaches in the Susquehanna River Basin by Subbasin

Abbreviations used in Tables B1 through B5

Table Headings:

STRMNAME -	Name of stream or river.
UPMILES -	Beginning of stream reach in miles upstream of mouth.
DNMILES -	Ending of stream reach in miles upstream of mouth.
RCHCLASS -	Designated use/classification of stream reach (see Appendix A)
MILASS -	Total miles of stream reach that is assessed for use support.
MILATT -	Total miles of stream reach that attained (full support) designated use.
MNOTATT -	Total miles of stream reach that did not attain (not supporting) designated use.
MPARATT -	Total miles of stream reach that partially attained (partial support) designated use.
CAUSE1-	Major cause of stream use impairment.
CAUSE2 -	Minor cause of stream use impairment.
SOURCE1 -	Major source of stream use impairment.
SOURCE2 -	Minor source of stream use impairment.

Source Codes:

MW -	Municipal wastes
IW -	Industrial wastes
DW -	Domestic wastes
OPS -	Other point sources
AMD -	Acid mine drainage
AP -	Acid precipitation
AGR -	Agricultural runoff
URBRO -	Urban runoff
ONS -	Other nonpoint sources
UNK -	Unknown
RESEX -	Resource extraction (non-coal)
LNDF -	Landfills
HYDRO -	Hydromodification

Cause Codes:

UNK -	Unknown
TOX -	Toxics
PEST -	Pesticide
ORG -	Organics
MET -	Metals
NH3 -	Ammonia
CL -	Chlorine
OIN -	Other inorganics
NUTR -	Nutrients
PH -	pH
SILT -	Siltation
DO -	Organic enrichment/ dissolved oxygen
TDS -	Total dissolved solids
THRM -	Thermal modification
FLOW -	Flow alteration
HAB -	Habitat alteration
BAC -	Bacteria/pathogens
OIL -	Oil and Grease
ODOR -	Taste and odor
SUSP -	Suspended solids
AQPL -	Noxious aquatic plants
FILL -	Filling and draining
SO4 -	Sulfate

Table B1. Assessed Stream Reaches in the Chemung Subbasin

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
Bennett Creek	7	0	C	7	7						
Bentley Creek	1.5	0	C	1.5	1.5						
Bentley Creek	11.3	1.5	WWF	9.8	5.8	3	1	HAB	HAB	HYDRO	HYDRO
Canacadea Creek	4.9	0	C	4.9	1.9		3	MET		UNK	
Canisteo River	49.3	41.8	C	7.5	7.5						
Canisteo River	41.8	40	C	1.8	1.8						
Canisteo River	40	34.3	C(T)	5.7	4.7		1	HAB	TDS	URB	RESEX
Canisteo River	34.3	31.1	C	3.2		3.2		HAB	TDS	URB	URB
Canisteo River	31.1	0	C	31.1	25.4	5.7		HAB	TDS	URB	URB
Chemung River	45	37	C	8	8						
Chemung River	37	27	C	10	10						
Chemung River	27	19	C	8	2		6	MET	NUTR	UNK	UNK
Chemung River	19	11.5	C	7.5	7		0.5	MET	NUTR	UNK	UNK
Chemung River	11.5	9.5	WWF	2	2						
Chemung River	9.5	6.8	C	2.7	2.7						
Chemung River	6.8	0	WWF	6.8	6.8						
Cohocton River	58.1	51.7	C(TS)	6.4	6.4						
Cohocton River	51.7	49.9	C(TS)	1.8	1.8						
Cohocton River	49.9	40.7	C(T)	9.2	6.2		3	NUTR	DO	AGR	AGR
Cohocton River	40.7	39.2	B(T)	1.5			1.5	NUTR	MET	AGR	URB
Cohocton River	39.2	19.7	C(T)	19.5	18.5	1		NUTR	TDS	AGR	IW
Cohocton River	19.7	0	C	19.7	13.7		6	TDS		AGR	
Corey Creek	8.9	0	CWF	8.9	8.9						
Cowanesque River	2.2	0.7	C	1.5		0.5	1	MET	NUTR	HYDRO	HYDRO MW
Cowanesque River	30	13	WWF	27	11.5		15.5	HAB	OIN	HYDRO	IW
Cowanesque River	32.7	30	WWF	2.7			2.7	HAB		HYDRO	
Cowanesque River	0.7	0	C	0.7			0.7	NUTR	MET	HYDRO MW	HYDRO
Cowanesque River	13	2.2	WWF								
Crooked Creek	22.4	7.4	WWF	15	3		12	NUTR	TSS	AGR	AGR
Fellows Creek	5.9	0	CWF	5.9	5.9						
Fivemile Creek	18.8	0	C	18.8	15.8		3	SILT	HAB	AGR	AGR
Hills Creek	7.42	0	CWF	7.42	7.42						

Table B1. Assessed Stream Reaches in the Chemung Subbasin (Continued)

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
Johnson Creek	3.9	0	CWF	3.9			3.9	MET	SILT	OPS	ONS
Karr Valley Creek	8	0	C	8	8						
Meads Creek	8.7	0	C(T)	8.7	8.2		0.5	HAB		UNK	
Mill Creek	14.7	0.8	TSF	13.9	13.9						
Morris Run	5.3	0	CWF	5.3		5.3		pH	MET	AMD	AMD
Mud Creek	12.4	0	C	12.4	12.4						
Newtown Creek	2.8	0	C	2.8			2.8	TDS	TDS	MW	URB
North Branch Tusearora Creek	17.6	0	C	17.6	17.6						
North Fork Cowanesque River	9.9	7.8	C(T)	2.1	2.1						
North Fork Cowanesque River	7.8	4.5	CWF	3.3			3.3	SILT		AGR	
North Fork Cowanesque River	4.5	0	CWF	4.5			4.5	NUTR		AGR	
Post Creek	0.6	0	C	0.6			0.6	TDS	HAB	URB	HYDRO
Seeley Creek	13.4	10.4	CWF	3			3	HAB	MET	HYDRO	UNK
Seeley Creek	10.4	6.9	C	3.5			3.5	HAB	MET	HYDRO	UNK
Seeley Creek	6.9	0	C(T)	6.9			6.9	HAB		HYDRO	
Sing Sing Creek	3.8	0	C(T)	3.8	2.8		1	NUTR		AGR	
South Creek	16.3	6	TSF	10.3	8.3		2	HAB		AGR	
South Creek	6	0	C	6	4		2	HAB		HYDRO	
Tennile Creek	8.8	6	C	2.8	2.8						
Tennile Creek	6	0	C(TS)	6	6						
Tioga River	13.1	0	C	13.1			13.1	UNK		UNK	
Tioga River	20	13.1	WWF	6.9			6.9	PH		AMD	
Tioga River	54	20	CWF	34	7.88	26.12		PH	MET	AMD	AMD
Troups Creek	5.2	0	CWF	5.2	4.7		0.5	HAB		HYDRO	
Tuscarora Creek	23.9	0	C	23.9	22.9		1	HAB	TDS	URBRO	URBRO
Twelvemile Creek	12.1	10	C	2.1	2.1						
Twelvemile Creek	10	5.9	C(T)	4.1	4.1						
Twelvemile Creek	5.9	0	C(TS)	5.9	5.9						
Wynkoop Creek	7.9	0	C	7.9	7.9						

Table B2. Assessed Stream Reaches in the Upper Susquehanna Subbasin

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
Apalachin Creek	13.2	6.44	CWF	6.76	6.76						
Apalachin Creek	6.44	0	C	6.44	6.44						
Cascade Creek	1.7	0	CWF	1.7	1.7						
Cascade Creek	4	1.7	C(T)	2.3	2.3						
Cayuta Creek	1.7	0	WWF	1.7	1.7						
Choconut Creek	9.1	0	C	9.1	9.1						
Little Snake Creek	2.8	0	C	2.8	2.8						
Little Snake Creek	10.62	6.74	CWF	3.52	3.52						
Little Snake Creek	6.74	0	C	6.74	6.74						
Snake Creek	22.5	1.8	CWF	20.7	20.7						
Snake Creek	1.8	0	C	1.8	1.8						
Susquehanna River	377.7	357.7	B	20	20						
Susquehanna River	343	339	B	4			4	NUTR		UNK	
Susquehanna River	339	330	A	9	9						
Susquehanna River	291	284	WWF	7	7						
Trowbridge Creek	2	0	CWF	2	2						
Trowbridge Creek	7.7	2	C	5.7	5.7						
Wappasening Creek	18.4	1.9	WWF	16.5	16.5						
Wappasening Creek	1.9	0	C	1.9	1.9						

Table B3. Assessed Stream Reaches in the Middle Susquehanna Subbasin

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
Black Creek	23.5	0	CWF	23.5		2	21.5	pH	MET	AMD	AMD
Bowman Creek	19.8	0	HQ-CWF	19.8	19.8						
Bowman Creek	29.5	19.8	HQ-CWF	9.7	9.7						
Briar Creek	7.1	0	CWF	7.1	7.1						
Catawissa Creek	20.5	0	TSF	20.5		20.5		PH	MET	AMD	AMD
Choconut Creek	16	9.1	WWF	6.9	6.9						
East Branch Briar Creek	7.2	0	CWF	7.2	7.2						
Fishing Creek	30.6	13.7	CWF	16.9	16.9						
Fishing Creek	13.7	9.5	TSF	4.2	4.2						
Fishing Creek	9.5	0	WWF	9.5	9.5						
Harveys Creek	5.6	0	CWF	5.6	5.1		0.5	UNK		URBRO	
Harveys Creek	20.2	5.6	HQ-CWF	14.6	14.6						
Hunlock Creek	7.7	0	CWF	7.7	2.2		5.5	UNK		UNK	
Huntingdon Creek	5.7	0	TSF	5.7			5.7	UNK		UNK	
Huntington Creek	6.2	0	TSF	6.2	6.2						
Lackawanna River	2.6	0	WWF	2.6		2.6		MET	NH3	AMD	DW
Lackawanna River	25.2	2.6	WWF	22.6			22.6	NUTR	HAB	MW	URBRO
Lackawanna River	37	33.5	TSF	3.5	3.5						
Lackawanna River	40.3	37	TSF	3.3	3.3						
Leggetts Creek	5.8	0	CWF	5.8	4.8	1		NUTR		DW	
Little Fishing Creek	23.2	0	CWF	23.2	23.2						
Little Wapwallopen Creek	11.7	0	CWF	11.7	11.7						
Mahoning Creek	1.6	0	TSF	1.6			1.6	TDS	HAB	URBRO	URBRO
Mehoopany Creek	6.5	0	CWF	6.5	6		0.5	UNK		UNK	
Mehoopany Creek	20.4	6.5	HQ-TSF	13.9	13.9						
Meshoppen Creek	9.6	0	CWF	9.6	9.1		0.5	UNK		UNK	
Nanticoke Creek	5	0	CWF	5	1.4	3.6		MET	TDS	AMD	AMD
Nescopeck Creek	25.7	0	TSF	25.7	12.2	13.5		pH	MET	AMD	AMD
Nescopeck Creek	40.4	25.7	HQ-CWF	14.7	14.7						

Table B3. Assessed Stream Reaches in the Middle Susquehanna Subbasin (Continued)

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
Newport Creek	4.8	0	CWF	4.8		4.8		MET		AMD	
Roaring Brook	20.9	0	CWF	20.9	20.4		0.5	UNK		UNK	
Roaring Creek	20.2	14.08	HQ-CWF	6.12	6.12						
Roaring Creek	2.4	0	TSF	1.2	0.7		0.5	UNK		UNK	
Roaring Creek	2.4	0	TSF	1.2	1.2						
Roaring Creek	14.08	2.4	TSF	11.68	11.68						
Shickshinny Creek	10.3	0	CWF	10.3	8.3		2	FLOW		HYDRO	
Solomon Creek	9	0	CWF	9	4.2	1.5	3.3	pH	SILT	AMD	URBRO
South Branch Roaring Creek	1.8	0	CWF	1.8			1.8	NUTR		AGR	
Stony Creek	3.2	0	CWF	3.2	3.2						
Sugar Creek	11.6	0	WWF	11.6	10.6		1	SILT		AGR	
Sugar Creek	32.2	11.6	TSF	20.6	10.6		10	HAB		AGR	
Sugar Run Creek	9.5	0	CWF	9.5	9		0.5	UNK		UNK	
Susquehanna River	284	244.2	WWF	39.8	37.8		2	UNK		UNK	
Susquehanna River	244.2	204.5	WWF	39.7	39.7						
Susquehanna River	204.5	199.8	WWF	2.3	2.3						
Susquehanna River	204.5	199.8	WWF	2.4	2.4						
Susquehanna River	199.8	196.8	WWF	3	3						
Susquehanna River	196.8	160.3	WWF	36.5			36.5	SO4	NUTR	AMD	DW AGR
Susquehanna River	160.3	142.5	WWF	17.8	10.5		7.3	SO4	NUTR	AMD	DW AGR
Susquehanna River	142.5	140	WWF	2.5	2.5						
Susquehanna River	140	134.5	WWF	2.7			2.7	UNK		UNK	
Susquehanna River	140	134.5	WWF	2.8			2.8	UNK		UNK	
Susquehanna River	134.5	124.5	WWF	9.7	9.7						
Toby Creek	11.6	0	CWF	11.6	2	4	5.6	SILT DO	UNK	URBRO OPS	UNK
Towanda Creek	4.1	0	WWF	4.1	4.1						
Towanda Creek	29.7	4.1	TSF	25.6	24.6		1	UNK		AGR	
Tunkhannock Creek	6.3	0	TSF	6.3	4.3		2	SILT		URBRO	
Tunkhannock Creek	19.4	6.3	TSF	13.1	13.1						
Wapwallopen Creek	25.3	0	CWF	25.3	23.3		2				

Table B3. Assessed Stream Reaches in the Middle Susquehanna Subbasin (Continued)

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
West Branch Briar Creek	3.6	0	CWF	3.6	2.6		1	UNK		AGR	
Wyalusing Creek	14.7	0	WWF	14.7	7.7		7	NUTR TDS	HAB	DW	AGR
Wyalusing Creek	19.2	14.7	WWF	4.5	3.5		1	UNK		UNK	
Wysox Creek	14.5	0	CWF	14.5	13.5		1	UNK		UNK	

Table B4. Assessed Stream Reaches in the Juniata Subbasin

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
Aughwick Creek	30.2	0	TSF	30.2	30.2						
Beaverdam Branch Juniata River	14	0	WWF	14			14	UNK NUTR	Metals	URBRO OPS	AMD
Blacklog Creek	4.5	0	CWF	4.5	4		0.5	UNK		UNK	
Bobs Creek	10.77	0	CWF	10.77	5.77		5	NUTR		AGR	
Bobs Creek	16.65	10.77	HQ-CWF	5.88	5.88						
Browns Gap Run	2.95	0	CWF	2.95	2.95						
Brush Creek	12.9	0	WWF	12.9	12.9						
Buffalo Creek	30.8	0	HQ-CWF	30.8	30.8						
Carothers Gap Run	3	0	CWF	3	3						
Clover Creek	23.7	0	HQ-CWF	23.7	23.7						
Cocolamus Creek	6	0	TSF	6	6						
Cocolamus Creek	20	6	TSF	14	14						
Delaware Creek	4.5	0	TSF	4.5	3		1.5	UNK	UNK	MW	OPS URBR
Dunning Creek	27.4	0	WWF	27.4	7.4		20	SILT	HAB	AGR	AGR
East Licking Creek	9.4	0	CWF	9.4	9.4						
Fort Run	5.28	0	CWF	5.28	5.28						
Frankstown Branch Juniata River	38.65	20.8	WWF	17.85	0.45	1	16.4	TDS	NUTR	IW	OPS
Frankstown Branch Juniata River	20.8	6.1	TSF	14.7			14.7	UNK	UNK	OPS	IW
Frankstown Branch Juniata River	6.1	0	WWF	6.1			6.1	UNK		UNK	
Frankstown Branch Juniata River	44.9	38.65	TSF	6.25	6.25						
Great Trough Creek	27.1	0	TSF	27.1	17.1		10	SILT		AGR	
Jacks Creek	8.3	0	TSF	8.3	8.3						
Juniata River	103.4	83.2	WWF	20.2	15.2		5	HAB		UNK	
Kishacoquillas Creek	24.4	6.8	TSF	17.6	7.6	5	5	SILT	NUTR	AGR	AGR
Kishacoquillas Creek	6.8	0	TSF	6.8	1.5		5.3	SILT	UNK	URBRO	OPS
Laurel Run	2.2	0	CWF	2.2	2.2						

Table B4. Assessed Stream Reaches in the Juniata Subbasin (Continued)

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
Little Aughwick Creek	2.8	0	TSF	2.8	2.8						
Little Juniata River	31.2	13.2	TSF	18			18	TDS	NUTR	URBRO	OPS
Little Juniata River	13.2	6.6	TSF	4.6	4.6						
Little Juniata River	6.6	0	CWF	6.6	2.8		3.8	SILT		UNK	
Logan Run	2.23	0	CWF	2.23	2.23						
Narrows Branch Tuscarora Creek	9.8	1.9	CWF	7.9	7.9						
Narrows Branch Tuscarora Creek	1.9	1.1	CWF	0.8	0.8						
Narrows Branch Tuscarora Creek	1.1	0	CWF	1.1	1.1						
Old Womans Run	4.27	0	CWF	4.27	4.27						
Raystown Branch Juniata River	116.9	35	TSF	81.9	47.1		34.8	TDS NUTR	NUTR MET	URBRO OPS	OPS AMD
Raystown Branch Juniata River	35	0	WWF	35	29		6	NUTR		HYDRO	
Roaring Run	0.8	0	CWF	0.8	0.8						
Shade Creek	9.9	0	TSF	9.9	9.9						
Shaver Creek	19	0	HQ-CWF	19	17		2	HAB		UNK	
Sideling Hill Creek	0.5	0	HQ-CWF	0.5	0.5						
South Bald Eagle Creek	8.3	0	TSF	8.3	8.3						
Spruce Creek	13	0	HQ-CWF	13	8		5	NUTR		AGR	
Standing Stone Creek	33.1	0	HQ-CWF	33.1	33.1						
Standing Stone Creek	35.5	33.1	HQ-CWF	2.4	2.4						
Sugar Run	3.98	0	CWF	3.98	3.98						
Three Springs Creek	11.3	0	CWF	11.3	11.3						
Tuscarora Creek	45.4	0	CWF	45.4	45		0.4	UNK		UNK	
Tuscarora Creek	49	45.4	CWF	3.6	3.6						
Willow Run	6.8	0	HQ-CWF	6.8	6.8						
Yellow Creek	19.7	0	HQ-CWF	19.7	19.7						

Table B5. Assessed Stream Reaches in the Lower Susquehanna Subbasin

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
Armstrong Creek	14.8	0	TSF	14.8	13.8		1	UNK		AGR	
Beaver Creek	9.8	0	WWF	9.8	8.3		1.5	HAB	NUTR	URBRO	URBRO
Bermudian Creek	8.4	0	WWF	8.4	8.4						
Big Beaver Creek	8	0	TSF	8	6.9	0.5	0.6	NUTR		UNK	
Big Branch Deer Creek	5.64	4.28	CWF	1.36			1.36	UNK		UNK	
Big Branch Deer Creek	4.28	0	III-P	4.28	4.28						
Chickies Creek	29.9	0	WWF	29.9	2.9		27	NUTR	NUTR	AGR	ONS
Clark Creek	29.8	0	HQ-CWF	29.8	29.8						
Cocalico Creek	26.6	0	WWF	26.6	11.6		15	NUTR	TDS	AGR	AGR
Codorus Creek	37.4	29.9	TSF	7.5	7.5						
Codorus Creek	29.9	25	CWF	4.9	3.9		1	FLOW		HYDRO	
Codorus Creek	25	0	WWF	25	1	4	20	TDS	HAB	IW	IW
Conestoga Creek	60	31.45	WWF	28.55	1.45		27.1	NUTR HAB	UNK	AGR	IW
Conestoga Creek	31.45	14.17	WWF	17.28			17.28	NUTR	HAB	URBRO	HYDRO
Conestoga Creek	14.17	0	WWF	14.17			14.17	NUTR	TDS	AGR	AGR
Conodoguinet Creek	15.8	0	WWF	15.8	11		4.8	HAB	NUTR	URBRO	ONS
Conodoguinet Creek	83.3	69.7	WWF	13.6	12.8		0.8	UNK		AGR	
Conodoguinet Creek	41.83	15.8	WWF	26.03	17.03		9	NUTR	HAB	MW	AGR URBRO
Conodoguinet Creek	54.77	41.83	WWF	12.94	12.94						
Conodoguinet Creek	69.7	54.77	WWF	14.93	13.63		1.3	UNK		AGR	
Conowingo Creek	19.6	4	CWF	15.6	5.6		10	SILT	NUTR	AGR	AGR
Conowingo Creek	4	0	I-P	4			4	SILT	NUTR	AGR	AGR
Deep Creek	22.2	0	CWF	22.2	17.7		4.5	TDS		AMD	
Deer Creek	51.7	44.5	CWF	7.2	7.2						
Deer Creek	30.5	0	IV-P	30.5	29.9		0.6	UNK		UNK	
Deer Creek	44.5	30.5	IV-P	14	14						
East Branch Octoraro Creek	16.2	0	TSFmf	8.1	6.7		1.4	NUTR		AGR	
East Conewago Creek	18.6	0	TSF	9.3	8.3		1	NUTR		AGR	
East Conewago Creek	18.6	0	TSF	9.3	8.3		1	NUTR		AGR	

Table B5. Assessed Stream Reaches in the Lower Susquehanna Subbasin (Continued)

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
East Mahantango Creek	17	0	WWF	8.5	7.3		1.2	BUTR	NUTR	AGR	ONS
East Mahantango Creek	17	0	WWF	8.5	7.3		1.2	NUTR	NUTR	AGR	ONS
East Mahantango Creek	35.1	17	CWF	18.1	17.1		1	UNK		UNK	
Ebaughs Creek	7.44	1.25	CWF	6.19	4.11		2.08	TDS	CL	MW	MW
Ebaughs Creek	1.25	0	III-P	1.25			1.25	TDS	CL	MW	MW
Elk Creek	18.9	0	CWF	18.9	18.9						
Falling Branch Deer Creek	4.95	4.7	CWF	1.25	1.25						
Falling Branch Deer Creek	4.7	0	IV-P	4.7	4.7						
Glen Rock Valley	2.82	0	CWF	2.82	2.82						
Hammer Creek	19.4	0	TSF	19.4	14.4		5	NUTR	HAB	AGR	UNK
Kreutz Creek	17.6	0	HQ-CWF	17.6	15.6		2	HAB		HYDRO	
Laurel Run	6.3	0	CWF	6.3	6.3						
Letort Spring Run	7.4	0	CWF	7.4	6.9		0.5	NUTR		UNK	
Little Chickies Creek	17.1	0	TSF	17.1	12.1		5	NUTR	NUTR	AGR	ONS
Little Conestoga Creek	19.8	0	WWF	19.8	9.8		10	NUTR	TDS	AGR	AGR
Little Shamokin Creek	12.7	0	CWF	12.7	12.7						
Little Wieoniseo Creek	12.8	8.36	WWF	4.44			4.44	SILT		AGR	
Little Wieoniseo Creek	8.36	0	WWF	8.36	1		7.36	HAB		AGR	
Long Arm Creek	2.9	0	WWF	2.9	0		2.9	UNK		AGR	
Mahanoy Creek	25.4	0	WWF	25.4		25.4		MET		AMD	
Manada Creek	15.2	0	WWF	15.2	13.9		1.3	HAB		AGR	
Middle Creek	35.9	0	WWF	35.9	27.4		8.5	ORG	UNK	HYDRO	OPS
Middle Spring Creek	6.6	0	CWF	6.6	6.6						
Middle Spring Creek	7	6.6	CWF	0.4	0.4						
Mill Creek	23.5	0	WWF	23.5	13.5		10	NUTR		AGR	
Mill Creek	26	23.5	CWF	2.5	2.5						
Mountain Creek	13.9	0	TSF	13.9	13.9						
Muddy Creek	15.4	0	WWF	15.4	10.4		5	HAB		AGR	
Muddy Creek	16.7	0	TSF	16.7	16.7						

Table B5. Assessed Stream Reaches in the Lower Susquehanna Subbasin (Continued)

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
North Branch Mahantango Creek	13.3	0	TSF	13.3	13.3						
North Branch Middle Creek	2.7	0	WWF	2.7	2.2		0.5	UNK		UNK	
North Branch Muddy Creek	11.8	0	CWF	11.8	11.8						
Octoraro Creek	8.6	0	IV-P	8.6			8.6	NUTR	-	AGR	
Paxton Creek	12.8	0	WWF	12.8	4.4	2.9	5.5	NUTR TDS MET	NUTR	URBRO	OPS
Penns Creek	15	0	WWF	15	15						
Penns Creek	33.7	22	HQ-CWF	11.7	11.7						
Penns Creek	53.3	37.5	HQ-CWF	15.8	15.8						
Pequea Creek	52.3	0	WWF	52.3	32.3		20	NUTR	HAB	AGR	AGR
Pine Creek	20.4	0	CWF	20.4	19.4		1	HAB		HYDRO	
Pine Creek	1	0	CWF	1			1	TDS		AMD	
Pine Creek	3.2	1	CWF	3.2			3.2	TDS		AMD	
Pine Creek	22.8	3.2	CWF	22.8	14.5		8.3	TDS		AMD	
Powell Creek	16.2	0	TSF	16.2	16.2						
Quittapahilla Creek	16.5	0	TSF	16.5	11.3		5.2	NUTR	NUTR	AGR	OPS
Scott Creek	3	0	TSF	3		3		NH3		DW	
Shamokin Creek	34.7	0	WWF	34.7		34.7		MET		AMD	
Sherman Creek	38	0	WWF	38	38						
South Branch Codorus Creek	14.5	0	WWF	14.5	4.5		10	HAB		HYDRO	
South Branch Conewago Creek	16.6	0	WWF	16.6	14.6		2	NUTR		AGR	
South Branch Conewago Creek	22.1	16.6	WWF	5.5	5.5						
South Branch Muddy Creek	10.1	0	HQ-CWF	10.1	10.1						
Spring Creek	2.8	0	WWF	2.8	2.5		0.3	NUTR		UNK	
Susquehanna River	124.5	104.5	WWF	20	20						
Susquehanna River	104.5	56.2	WWF	48.3	48.3						
Susquehanna River	56.2	15	WWF	41.2	41.2						

Table B5. Assessed Stream Reaches in the Lower Susquehanna Subbasin (Continued)

STRMNAME	UPMILES	DNMILES	RCHCLASS	MILASS	MILATT	MNOTATT	MPARATT	CAUSE1	CAUSE2	SOURCE1	SOURCE2
Susquehanna River	15	0	I-P	7.5	7.5						
Susquehanna River	15	0	I-P	7.5	7.5						
Swatara Creek	20.3	0	WWF	20.3	20.3						
Swatara Creek	58.5	20.3	WWF	38.2	22.85		15.35			AMD	
Trindle Spring Run	5.4	0	CWF	5.4	5		0.4	UNK		UNK	
UNT 07628	3.49	1.92	HQ-CWF	1.57	1.57						
UNT 07628	1.92	0	CWF	1.92	1.92						
UNT 08181	1.69	0	CWF	1.69	1.69						
UNT 16835	4.22	0	CWF	4.22			4.22	SILT		AGR	
UNT 16835	6.45	4.22	HQ-CWF	2.33	2.33						
UNT 16844	0.37	0	HQ-CWF	0.37	0.37						
UNT 16938	1.84	0	WWF	1.84			1.84	HAB		AGR	
UNT 16951	1.62	0	WWF	1.62			1.62				
UNT 16963	1.73	0	WWF	1.73	1.73						
UNT 16977	1.78	0	WWF	1.78			1.78	NUTR		AGR	
UNT 16988	5.1	0	WWF	5.1	5.1						
UNT 17052	1.54	0	CWF	1.54			1.54	HAB		URBRO	
UNT 17058	2.4	0	CWF	2.4	2.4						
West Branch Octoraro Creek	19.7	0	HQ-CWFmf	19.7	19		0.7	NUTR		AGR	
West Conewago Creek	34.1	0	WWF	34.1	33.1		1	HAB		HYDRO	
West Conewago Creek	60.1	34.1	TSF	26	13.95		12.05	HAB	NUTR	HYDRO	AGR
West Mahantango Creek	4.7	2.1	WWF	1.3	1.3						
West Mahantango Creek	4.7	2.1	WWF	1.3	1.3						
Wiconisco Creek	1.02	0	WWF	1.02			1.02	UNK		URBRO	
Wiconisco Creek	42	35.47	WWF	6.53	5.53		1	MET	NH3	AMD	MW
Wiconisco Creek	22	1.02	WWF	20.98			20.98	NUTR	TDS	AGR	AMD
Wiconisco Creek	27.25	22	WWF	5.25			5.25	MET SILT	NUTR	AMD	UNK
Wiconisco Creek	28.28	27.25	WWF	1.03			1.03	MET		AMD	
Wiconisco Creek	35.47	28.28	WWF	7.19			7.19	MET		AMD	
Yellow Breeches Creek	24.1	0	CWF	24.1	20.4		3.7	HAB	TDS	URBRO	UNK
Yellow Breeches Creek	58.4	34.7	HQ-CWF	23.7	22.7		1	HAB		AGR	